



Working with cities worldwide to
keep plastic out of nature by 2030



Resources & Waste
Advisory Group

Towards Circular Systems: Lessons from Plastic Smart Cities

Translating local interventions
into scalable solutions



→ SIMWA plastic upcycling
- San Isidro, Philippines



Acknowledgement

The development of this package of learnings was made possible by the World Wide Fund for Nature (WWF) Plastic Smart Cities (PSC) programme in collaboration with Resources and Waste Advisory Group (RWA).

The interventions highlighted throughout this report was supported by TVAksjonen (TVA) via NRK (Norwegian Broadcasting Corporation); Norad (Norwegian Agency for Development Cooperation); BMU (German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety); The Coca-Cola Foundation; and the Environment and Conservation Fund Hong Kong.

We extend sincere appreciation to the WWF national teams in Hong Kong, Indonesia, the Philippines, Thailand, and Viet Nam, and acknowledges the contributions of the local and provincial governments, communities, solution providers, private sector actors and other partners for their collaboration in the PSC interventions across the region.

Recommended citation

WWF and RWA Group. (2025). Towards Circular Systems: Lessons Learned from Plastic Smart Cities: Translating local interventions into scalable solutions. WWF, Gland, Switzerland.

Front cover image © Photo by Gaurav Kumar on Pexels

Back cover image © Julian Hahne / WWF-Indonesia

Copyright © 2025 WWF and RWA Group. Any reproduction in full or in part must mention the title and credit the above-mentioned publishers as copyright owners.

Design

Christine Sutanto (@typrist)

Veronica Maureen

Authors/Editors

RWA Group: Nicole Weber, Andrew Whiteman, Maya Zaatar

WWF: Jessica Chia, John Duncan, Jia Ling Lim, Yumi Nishikawa



Executive Summary

[Plastic Smart Cities \(PSC\)](#) is part of the World Wide Fund for Nature's (WWF) No Plastic in Nature initiative. As a pioneering global movement, the PSC programme is aimed at supporting on-the-ground action with cities to achieve zero plastic leakage into nature. Since its inception in 2018, PSC has worked with over 50 cities worldwide to implement innovative plastic pollution reduction strategies. With the ultimate objective of eliminating plastic leakage into the environment, PSC's diverse strategies have targeted key stages of the solid waste value chain while promoting circular economy approaches that prioritize plastic reduction, reuse, recovery and recycling.



© WWF-Thailand

This study captures learnings from a range of PSC pilot interventions conducted between 2018 and 2024 from five countries in East and Southeast Asia where we have had some of the longest history of engagement: China, Indonesia, the Philippines, Thailand, and Viet Nam. However, the PSC programme has continued to expand globally and this study does not cover the full extent of PSC work. This package has been structured as a living resource — designed to be expanded over time to include case studies from additional countries and a broader range of solutions as the initiative grows.

The study focuses on the following key questions:

- ① *What were the main types of solutions or approaches taken to promote circular economy and/or address plastic leakage reduction?*
- ② *Which worked well and why?
Which did not work well and why?*
- ③ *Which solutions or approaches have the potential for scale and impact and why?*



© Jessica Chia /
WWF Plastic Smart Cities

By systematically reviewing the successes, challenges, and scalability of these interventions, this report provides evidence to guide the implementation efforts of WWF and other organisations working in this space for upcoming interventions contributing to addressing plastic pollution.

This package includes 23 detailed case studies from the PSC programme, presented according to the different intervention points along the solid waste value chain, along with an enabling framework.

These case studies are categorised into four chapters based on the PSC Focus Areas:

Reduction



Educational initiatives driving behaviour change to reduce plastic waste (and improve waste segregation)



Business engagement strategies for waste reduction



Reuse and refill model piloting

Collection



Collection and Segregation approaches improving city service coverage and recycling value chain



Waste bank models empowering community-based waste management

Recovery and Recycling



Material Recovery Facilities enhancing waste recovery and recycling efforts



Enabling Framework



Local policy and regulation supporting effective waste management



Sustainable financing strategies generating revenue for plastic waste management



Monitoring and assessment enabling data-driven decisions

Each chapter dedicated to a PSC focus area includes a dedicated Introduction, Summary, and Recommendations section, highlighting key insights from the PSC case studies and providing actionable guidance tailored to national and local governments, producers, private sector, civil society organisations (CSOs), and communities. The Replication and Scaling chapter features key interventions to replicate or scale based on the stage of the value chain, while the final chapter on Investing in a Circular Economy is addressed to private sector actors, local governments, CSOs and other stakeholders with investment recommendations.

Methodology

This study synthesizes findings from data recorded by some of the longest running PSC projects along with primary data collection via stakeholder interviews combined with an external literature review. Interventions were evaluated using a weighted decision matrix, assessing six criteria: plastic waste reduction, scalability and replication potential, financial sustainability, behavioural change, policy influence, and stakeholder inclusivity to identify scalable and impactful practices. Interventions with the highest scores were then shortlisted and validated qualitatively, resulting in the 23 case studies featured in this report.

Lessons Learned



Reduction

Reduction refers to reducing the amount of plastic produced or consumed, addressing plastic pollution higher upstream by avoiding or significantly reducing the use of plastic products before they become waste. Effective interventions combine consumption-focused behavioural change, proactive business engagement, effective reuse and refill models, and strong supporting policy frameworks.



Educational initiatives effectively reduce plastic waste generation by embedding environmental awareness into school curricula, implementing systematic bans on single-use plastics (SUPs), enforcing plastic-free canteens potentially with a reuse model, and empowering

students through leadership and monitoring roles. Integrating hands-on, interactive learning methods and student-led actions, such as those used in Indonesia ([Case Study 1.1](#)), reinforced responsible waste disposal behaviours at school. Effective adoption of the plastic-free school model across all schools on the island of Con Dao, Viet Nam demonstrated how the positive support of local authorities led to scaled municipal-wide application of plastic reduction efforts, while it was also illustrated that waste separation practices further rely on sustained community education ([Case Study 1.2](#)). Consistent monitoring, clear messaging, teacher training, and policy frameworks are essential to ensuring long-term behaviour change. Additionally, offering structured financial incentives through mechanisms such as waste banks and junkshop partnerships, as demonstrated in Pak Meng, Thailand ([Case Study 1.3](#)), enhances student participation in separation at source and recycling.

To navigate this report effectively, readers can refer directly to the relevant focus area that aligns most closely with their project planning, design, or implementation needs or the 'Replication & Scaling' and 'Investing in a Circular Economy' chapters for recommendations.



Leaves turned into dishes

© Nguyen Ngoc Quang / WWF-Viet Nam

Business engagement on plastic waste reduction requires aligning regulatory frameworks with economic incentives, market opportunities, and proactive communication strategies. WWF's [Plastic ACTION](#) (PACT) initiative in Thailand ([Case Study 1.4](#)) exemplifies how engaging with food delivery and alternative packaging services can drive large-scale business participation through an opt-out system for plastic cutlery and eco-friendly packaging solutions, resulting in 67,000 businesses reducing substantial amounts of SUPs. Meanwhile, in Hue, Viet Nam ([Case Study 1.5](#)) the critical importance of providing affordable and practical alternatives to SUPs is recognised as key to facilitating the implementation of more sustainable outcomes. This can be supported using regulatory tools such as bans, plastic alternatives, and consistent monitoring frameworks can further encourage private sector participation and overcome barriers associated with the higher costs and consumer preferences for convenience driven SUPs. However, the use of alternative materials must be environmentally sound - see [WWF's Position Paper on Biobased and Biodegradable Plastics](#). Both cases highlight the necessity for ongoing municipal and private-sector cooperation, clear financial incentives, and accessible alternatives to overcome economic barriers and consumer preferences. Sustained public-private dialogue, combined with visible political endorsement, remains essential for maintaining private-sector commitment.

Scaling plastic reduction with businesses - Hat Yai, Thailand

Reuse and refill models reinforce upstream reduction by providing viable alternatives to single-use packaging, thereby reducing overall plastic consumption - it is a [key component to establishing a circular economy](#). For example, the closed-loop food delivery model in Hong Kong ([Case Study 1.6](#)) achieved substantial participation, with 15,400 participants over 22 months, by establishing strategic partnerships with a popular food delivery service and conducting effective awareness campaigns. However, sustaining long-term engagement poses challenges, including lower-than-anticipated return rates and ongoing operational costs. Lessons learned underline the importance of aligning consumer incentives closely with existing habits, ensuring financial viability, and enhancing operational efficiency through improved logistics and regulatory support. Effective policy frameworks and regulations mandating clear reuse targets, coupled with targeted incentives and widespread public education campaigns, are critical to ensuring that reuse and refill systems achieve lasting operational sustainability and consumer buy-in. See more examples here: [Reuse in the Global South](#) (WWF and EMF, 2025).

Reuse Food Delivery Model - Hong Kong SAR



Collection

Waste collection service provision, complemented by community-based waste management initiatives are critical for improving plastic waste recycling and reducing environmental leakage. Successful strategies depend on source separation – particularly clear separation of wet and dry waste – which significantly improves recyclability and reduces contamination. In Tan An, Viet Nam ([Case Study 2.1](#)), effective separation at source enabled 80% organic waste recovery with less than 1% contamination, leading to high-quality compost and reduced landfill waste. Continuous education, regular monitoring, and empowering waste collectors to educate residents at the point of collection are essential for improving source separation compliance. Additionally, feedback mechanisms such as showing residents the compost made from their own organic waste helped keep participation consistent at the household level, build trust, and deepen engagement, resulting in over 90% of households actively participating within two weeks and encouraging long-term behaviour change.

Waste banks and community-based waste management are valuable engagement and awareness raising platforms. Their success is driven by charismatic leadership, structured management, targeted incentives, and strategic partnerships that mobilise community action through educational support, utility payments, competitions that incentivise participation, and cash rewards as demonstrated in Depok, Indonesia ([Case Study 2.7](#)). Digital applications can help streamline waste bank transactions, though uptake has progressed gradually due to varying levels of digital literacy among participants. While waste banks have demonstrated strong social and educational value, their overall contribution to waste volume reduction and recycling efficiency remains relatively modest.

Factors influencing performance include constraints related to land availability for infrastructure, current processing capacity, financial sustainability, and the strength of connections to offtakers and end buyers – which may result in occasional bottlenecks for recovered materials. To support long-term viability, there is an opportunity to further strengthen market linkages, enhance capacity building in business and financial management, and clarify business models that can function independently of external funding. Integration into wider waste management systems – through partnerships with aggregators, junkshops, or larger Material Recovery Facilities (MRFs) – can further enhance operational efficiency and market access.

Recovery and Recycling

Recovery and recycling facilities play a pivotal role in sustainable waste management by enabling higher recycling rates and reducing plastic leakage. However, their effectiveness depends heavily on policy enforcement, particularly mandatory separation at source at the household and business levels. Recovery includes any process that extracts value from waste, including material recovery or energy recovery, while recycling refers to the process of reintroducing materials into the production cycle to create new products by sorting, cleaning, and processing materials into secondary raw materials that can replace virgin resources. Poor separation remains a key bottleneck across projects, increasing contamination and reducing feedstock quality. Strong policies, such as “no segregation, no collection” rules enforced in barangays (districts) of San Isidro, Philippines ([Case Study 3.5](#)), paired with targeted and continuous community education can improve operational outcomes and recovery efficiency.

Successful recovery and recycling initiatives rely heavily on thorough feasibility assessments, strong market linkages to guarantee offtake stability and sale of products, use of up-to-date and accurate baseline data, and integration within the broader waste value chain, as learned in Indonesia ([Case Study 3.4](#)). These considerations are essential to ensure accurate alignment between equipment, infrastructure, actual operational demands, material sourcing, processing capacity, and market stability. Establishing stabilisation mechanisms, such as Extended Producer Responsibility (EPR) frameworks, can mitigate market volatility, while the correct [operator model](#) selection is equally crucial; integrating new facilities within established value chains or partnering with existing market actors helps ensure smoother operations, greater market access, and long-term sustainability.

collection vehicle -
Bogor, Indonesia



© WWF-Indonesia

Enabling Framework

An enabling framework is the cornerstone of integrated solid waste management (ISWM), underpinning long-term sustainability, scalability, and overall effectiveness of plastic pollution reduction initiatives. Local policy and regulatory frameworks, sustainable financial strategies, and robust monitoring systems are essential to drive meaningful systemic change. Yet without clear enforcement or incentive mechanisms - such as fines, bans, or buy-back schemes - these policies may lack practical effectiveness. Well-coordinated policy implementation combined with active stakeholder engagement enhances plastic pollution reduction outcomes.

 **Local policy and regulation** are essential levers for driving systemic change in solid waste management, but they must be clearly defined, locally appropriate, and supported by robust enforcement mechanisms such as fines, bans, and buy-back schemes. In Hue, Viet Nam ([Case Study 4.1](#)), phased implementation of the PSC [Plastic Smart Guide](#)'s City Action Plan aligned the rollout of infrastructure with community training and engagement, resulting in over 570 tonnes of plastic leakage reduction across three implementation stages. This example illustrates the importance of synchronised activity planning and adaptive management. At the local level, governments can promote quick-win policies such as bans on single-use plastics or expanded access to collection points to demonstrate early success and build momentum. Crucially, community participation must be sustained through public education, [participatory action-oriented training](#), and consistent policy reinforcement to translate regulatory frameworks into long-term behavioural change.

 **Sustainable financing** is fundamental to the long-term viability and scalability of waste management systems. While short-term subsidies and donor support can kickstart initiatives, projects without embedded financial mechanisms risk stalling once external support ends. MRFs in Hat Yai, Thailand ([Case Study 4.2](#)) demonstrated how targeted financial incentives and private-sector partnerships can significantly improve cost-efficiency, reducing operational costs from USD 482 per tonne in 2023 to a forecasted USD 148 per tonne by 2025. However, the reliance on temporary subsidies highlights the need to institutionalise long-term instruments such as landfill pricing, product taxes, and mandatory EPR contributions to ensure financial stability and reduce dependency on external funds. Diversified revenue streams – such as collecting waste, selling materials, and processing recyclables – can provide a financial buffer for operational costs.

 **Monitoring and assessment** are essential for evidence-based decision-making and adaptive solid waste management. Accurate, up-to-date baseline data significantly enhances the effectiveness of interventions by enabling targeted strategies, as demonstrated in Cagayan de Oro, Philippines ([Case Study 4.3](#)). Tools such as the [Waste Wise Cities Tool \(WaCT\)](#) and [Waste Flow Diagram \(WFD\)](#) allow cities to update waste management plans based on reliable data, improve leakage tracking, and boost community participation in waste separation. Digital innovations can further support this process. Applications such as Indonesia's AKSI app ([Case Study 4.4](#)) offers real-time data capture for waste banks, enhancing transparency, operational oversight, and financial tracking. However, ensuring users are properly trained and supported is critical to maximising data accuracy, system adoption, and long-term success.



Recording volume of plastics collected - Surat Thani, Thailand

Replication and Scaling

Replication and scaling ISWM initiatives remains challenging due to substantial variations in local contexts, such as stakeholder interests, community awareness, and infrastructural capacities. For example, initiatives successful in urban areas may face significant adaptation hurdles when transferred to rural or island contexts, highlighting the importance of having tailored, context-specific approaches while considering scalability as one of the primary criteria to consider before investing time and energy into new projects.

Successful replication and scaling fundamentally depends on sustained political commitment, policy framework and enforcement, robust community awareness and engagement, strategic cross-sectoral partnerships, and diversified financing models to ensure long-term viability. Adopting a structured, step-by-step approach such as following the [PSC Plastic Smart Guide](#) for cities - starting with detailed baseline assessments, stakeholder alignment, tailored infrastructure investments, targeted training, and continuous monitoring - is critical to achieving sustainable systemic changes.

Key risks such as market volatility, financial dependency, limited infrastructure, and resistance to behavioural and technological shifts must be managed proactively through continuous stakeholder dialogue, adaptive policy frameworks, diversified funding sources, and institutionalised knowledge and leadership structures.

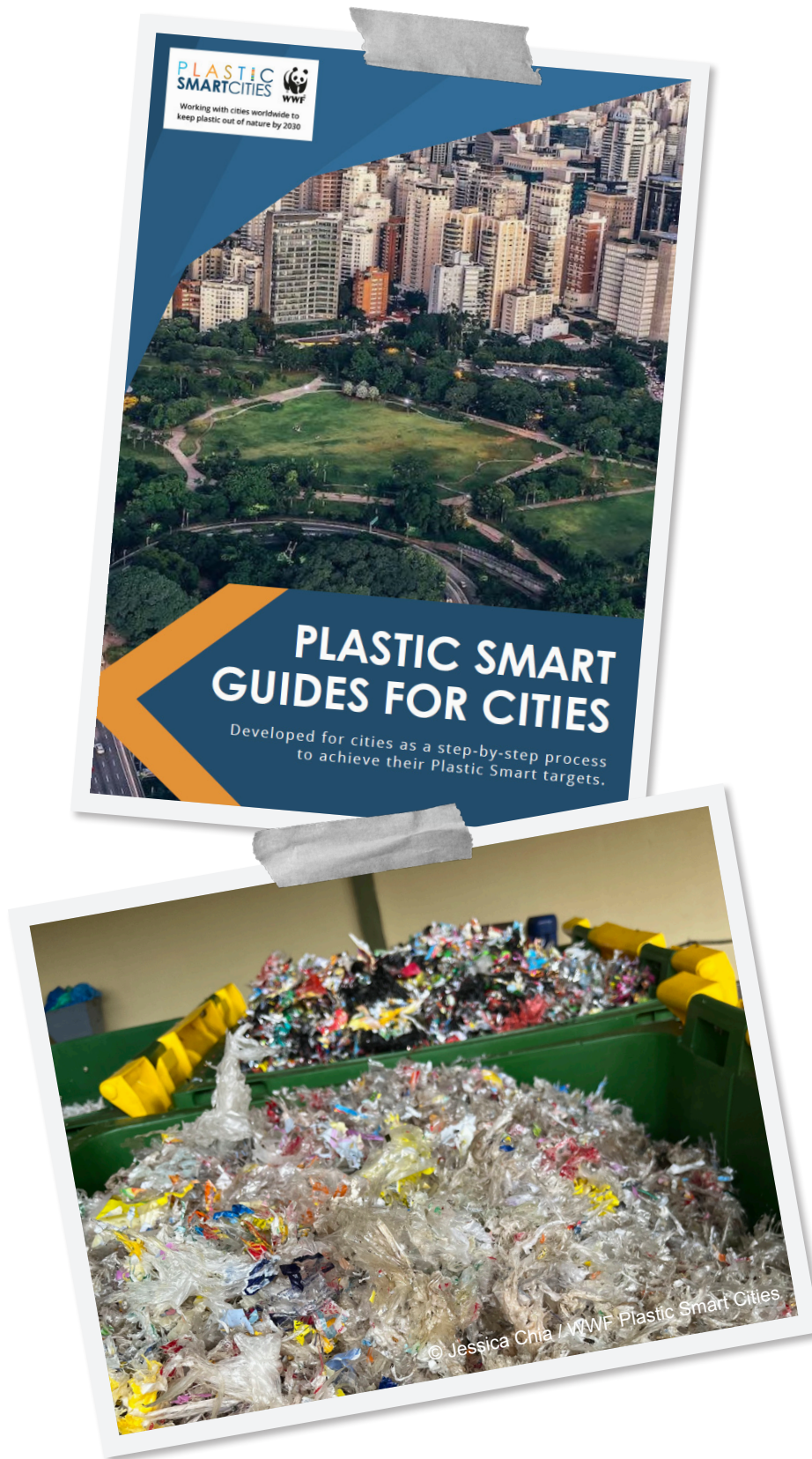
Plastic recovery -
Bogor, Indonesia

Investing in a Circular Economy

Investing in circular waste and resource management systems requires an integrated approach that addresses the entire waste value chain and a long-term commitment. Strategic investment is fundamental to ensure resource efficiency and maximum impact. Priority should be given to tackling upstream and midstream measures that focus on reduction and reuse such as reuse and refill systems, bans on single-use plastics, supporting business innovation and eco-design, promoting alternatives to plastic, and driving consumer behaviour change to minimise waste generation at source.

Downstream measures prioritise collection and separation, which represent the most significant investment. The focus should be expanding to areas of low collection, typically peri-urban, rural, and informal settlements. Backing formal and community-based collection systems and businesses that implement take-back schemes are effective, while promoting a two-stream separation service (wet and dry) helps to ensure higher material quality further down the waste chain. It's fundamental to ensure the waste value chain interface is strengthened and that market linkages are facilitated when building infrastructure.

Underpinning these are the need for investments in policy reform, institutional capacity building, public-private partnerships, blended financing, inclusive governance, data systems, and market development to ensure financial sustainability, policy alignment and long term resilience of circular systems.



Acknowledgements	1
Executive Summary	2
Abbreviations	11
Definitions	12

Introduction	13
Overview	14
Study Approach	14
Report Structure	14
Categorising the Case Studies	15
PSC Theory of Change	16

Contents

 1	Reduction	17
	Introduction	18
	Summary	19
	Recommendations	20
	Case Studies	25

 3	Recovery and Recycling	62
	Introduction	63
	Summary	64
	Recommendations	65
	Case Studies	69

 2	Collection	38
	Introduction	39
	Summary	40
	Recommendations	41
	Case Studies	43

 4	Enabling Framework	82
	Introduction	83
	Summary	84
	Recommendations	86
	Case Studies	89

Replication and Scaling	98
--------------------------------	----

Investing in a Circular Economy	105
--	-----

References	108
------------	-----

☆ **List of Case Studies**

1



Reduction

 Behavioural Change	1.1	Zero Waste Schools in Indonesia	25
	1.2	Con Dao Schools Go Plastic-Free	27
	1.3	Pak Meng School Cashes in on Waste	29
 Reduction	1.4	Thailand's Businesses Go Green	31
	1.5	Hue Makes Tourism Sustainable	34
 Reuse and Refill	1.6	Choose to Reuse: Closing the Loop on Takeaway Packaging in Hong Kong	36

2



Collection

 Collection and Separation	2.1	Household Waste Separation at Source in Tan An	43
	2.2	Expanded Waste Collection in Phu Quoc	46
	2.3	Boosting Collection in Manila with Blockchain Technology	48
	2.4	Hat Yai's Mall Take-Back Programme	50
 Community-based Waste Management	2.5	Surat Thani's Pathway to Waste Bank Success	52
	2.6	Kenanga Waste Bank: Building an Integrated System in Bogor	54
	2.7	Rumah Harum: The Last Centralised Waste Bank of Depok	57
	2.8	Songkhla's Fishermen Reel in Waste	60

3



Recovery and Recycling

 Recovery and Recycling	3.1	Jakarta's Waste Collection Collaboration	69
	3.2	Waste4Change Empowers Junkshops	71
	3.3	Cu Lao Cham: Small Island Scales Up Community MRFs	74
	3.4	Bogor: Bantar Kemang And Mekarwangi's Recycling	76
	3.5	Recycling for Change: San Isidro's Social Shift	79

4



Enabling Framework

 Local Policy and Regulation	4.1	Hue's City Action Plan for Clean Streets	89
 Sustainable Financing	4.2	Improving the Financial Sustainability of Thailand's MRFs	92
 Monitoring and Assessment	4.3	Addressing Plastic Leakage with Data in Cagayan de Oro	94
	4.4	Indonesia Waste Banks Go Digital	96



Abbreviations

3R	Reduce, Reuse, Recycle
API	Application Programming Interface
BS	Bank Sampah (Waste Bank)
BSF	Black Soldier Fly
CAP	City Action Plan
CAPEX	Capital Expenditure
CBO	Community-based Organisation
CE	Circular Economy
CSO	Civil Society Organisation
DLH	Indonesian Environment Agency
ECF	Environment and Conservation Fund
EPR	Extended Producer Responsibility
HKD	Hong Kong Dollar
HORECA	Hotels, Restaurants and Cafes
IDR	Indonesian Rupiah
ISWM	Integrated Solid Waste Management

KAP	Knowledge, Attitude and Practice
KII	Key Informant Interview
KPI	Key Performance Indicator
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NGO	Non-governmental Organisation
O&M	Operation and Maintenance
OPEX	Operational Expenditure
PACT	Plastic Action
PAOT	Participatory-Oriented Training
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PPOB	Online Bank Payment Point
PSC	Plastic Smart Cities
RCA	Residual Containment Area

SUP	Single-Use Plastic
SWM	Solid Waste Management
THB	Thai Baht
TOP	Thai Ocean Plastic
TPS	Tempat Penampungan Sementara (MRF)
TSWA	Thai Sea Watch Association
TVA	TV-Action (TV-aksjonen)
USD	US Dollar
VND	Viet Nam Dong
W4C	Waste For Change
WACS	Waste Analysis and Characterization Study
WaCT	Waste Wise Cities Tool
WaRM	Waste And Resources Management
WFD	Waste Flow Diagram
WSAS	Waste Separation at Source
WWF	World Wide Fund For Nature

Definitions

Aggregator	Platform/facility sitting at the interface between collectors and recyclers. Materials collected by individuals are sold to the aggregator, which will further process the waste for buyers/recyclers.	Replication	The transfer of a tested concept or initiative to a different location, aiming to reproduce its success in a new context.
Circular Economy	An economic system aimed at minimising waste and making the most of resources by keeping products, materials, and resources in use for as long as possible. It contrasts with the traditional linear economy of "take, make, dispose."	Scale-Up	The process of expanding a tested initiative by increasing its reach, impact, or financial sustainability, such as serving more people, increasing revenue, or influencing policy at a larger scale.
Collection	The process of gathering waste from households, businesses, and public spaces, either through formal municipal services or informal collection systems, before transport to recycling or disposal sites.	Service Chain	The sequence of activities and processes involved in delivering solid waste management services, from collection and transportation to recycling and final disposal, ensuring proper waste handling.
Controlled Disposal	The disposal of waste in designated, managed sites that adhere to environmental regulations and health standards.	TPS	Stands for 'Tempat Penampungan Sementara' in Bahasa. Refers to a transfer station in Indonesia, where waste is taken after being collected, and before being transported to further recycling or disposal. It sits at the primary/secondary collection interface.
Material Recovery Facility	(MRF; or materials reclamation facility, materials recycling facility, multi re-use facility) is a specialised recovery facility that receives, separates and prepares recyclable materials for marketing to further processors or end-user manufacturers. (WaCT, 2021)	TPS 3R	A TPS (see above) including sorting and/or recycling activities.
Off taker	Entity (usually private sector) buying the recovered materials from the recycling facilities.	Uncontrolled Disposal	The dumping of waste in unmanaged locations, such as open dumps.
Recycling	From WWF's Position Paper: Chemical Recycling Implementation Principles: Mechanical recycling is the most common form of recycling today. It refers to mechanical processing (sorting, washing and drying, chopping, grinding, and reprocessing) of material. Chemical recycling (also sometimes referred to as Advanced or Molecular recycling) in the plastic space refers to chemical, thermochemical, and combustion processes whereby some of the plastic waste undergoing treatment is turned back into its chemical building blocks enabling some of the waste material to be recycled into another plastic including plastic that can be used for food-grade applications. Recycling here refers to plastic-to-plastic recycling, not plastic-to-fuel applications.	Value Chain	The range of activities and stakeholders involved in the lifecycle of materials, from production and consumption to solid waste management, including collection, sorting and recycling.
		Waste Bank	A community-based initiative where residents can deposit source separated recyclable waste in exchange for monetary compensation or other incentives.



Introduction



Introduction

Overview

Plastic pollution is a global crisis that requires a diverse set of solutions, tailored to local contexts and engaging a wide range of stakeholders. The [Plastic Smart Cities](#) (PSC) programme supports the World Wide Fund for Nature’s (WWF) No Plastic in Nature agenda by implementing local interventions globally to prevent plastic leakage into the environment.

This publication features 23 case studies represented by five East and Southeast Asian countries (China, Indonesia, the Philippines, Thailand, and Viet Nam) that have been pioneering the PSC programme since 2018. These case studies highlight a small sample of the diverse interventions implemented across urban centres, coastal communities, and island-based areas globally. They further provide insights into what worked, what did not work, and the critical lessons learned that can support replication and scaling. Successful initiatives should not remain isolated pilot projects – they should serve as blueprints for broader change. Similarly, less successful concepts are mines of information on how to improve our design and planning of interventions for better scale-up.

Study Approach

The following key questions are the focus of this study: “What were the main types of solutions or approaches taken to promote circular economy and/or address plastic leakage reduction? Which worked well and why? Which did not work well and why? Which solutions or approaches have

the potential for scale and impact and why?” By highlighting both success factors and challenges, this publication seeks to go beyond documenting best practices.

This study synthesizes findings from data recorded by some of the longest running PSC projects, along with primary data collection via key informant interviews (KIIs) with relevant stakeholders, combined with an external literature review. Interventions were evaluated using a weighted decision matrix, assessing six criteria: plastic waste reduction, scalability and replication potential, financial sustainability, behavioural change, policy influence, and stakeholder inclusivity to identify scalable and impactful practices.

Each intervention was scored from 0 to 5, with weights applied to reflect the relative importance of each (e.g., plastic waste reduction was weighted more heavily than stakeholder inclusivity). Interventions with the highest scores were then shortlisted and validated qualitatively, resulting in the 23 case studies featured in this report. All shortlisted studies were reviewed by the relevant WWF teams and partners to ensure accuracy. Similarities were drawn from the case studies and literature to determine recommendations.

Report Structure

Each chapter of this report is structured around a core PSC Focus Area: Reduction, Collection, and Recovery and Recycling, all of which are supported by Enabling Frameworks. Within each chapter, readers will find an Introduction, a Summary of relevant case studies, and clearly outlined Recommendations.

Each case study presented in this report includes the following seven sub-sections:

- Key Lesson Learned:** Summary of the key takeaways from the case study being presented
- Background:** The baseline situation in the local context being studied, and the objectives of the PSC intervention within that context
- Key Successes:** Quantitative and/or qualitative results of the interventions
- Key Challenges:** The difficulties the intervention encountered
- Resources:** The supporting funding, human resources, partners/stakeholders, etc
- Enabling Factors:** The supporting elements which allowed the intervention to thrive
- Risks & Opportunities:** The elements which threatened or could slow down the success of the intervention as well as areas for growth and further scaling or replication



To navigate this report effectively, readers can refer directly to the relevant focus area that aligns most closely with their project planning, design, or implementation needs or the ‘Replication & Scaling’ and ‘Investing in a Circular Economy’ chapters for recommendations.

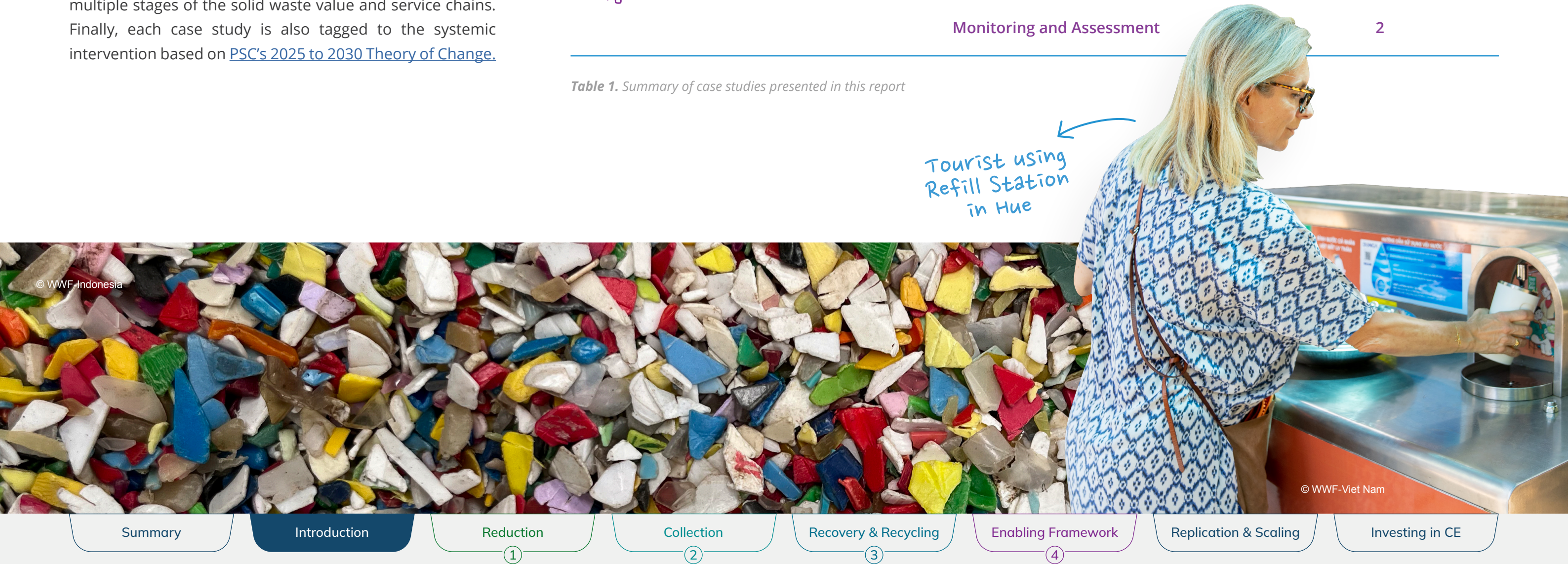
☆

Categorising the Case Studies

Each case study has been grouped into the PSC Focus Areas based on the solid waste management (SWM) stages (Reduction, Collection, and Recovery and Recycling), and a fourth category capturing Enabling Framework, as shown in [Table 1](#). They are also categorised into the nine PSC approaches to tackling plastic leakage (behavioural change, reduction, reuse/refill, collection, community-based waste management, recycling, local policy and regulation, sustainable financing, and monitoring and assessment). Initiatives may fall under several approaches as many interventions integrate multiple strategies to maximise impact, highlighting the interconnected nature of solutions for reducing plastic pollution. It further emphasises the need to adopt a systemic and holistic approach to develop integrated SWM solutions by simultaneously addressing multiple stages of the solid waste value and service chains. Finally, each case study is also tagged to the systemic intervention based on [PSC’s 2025 to 2030 Theory of Change](#).

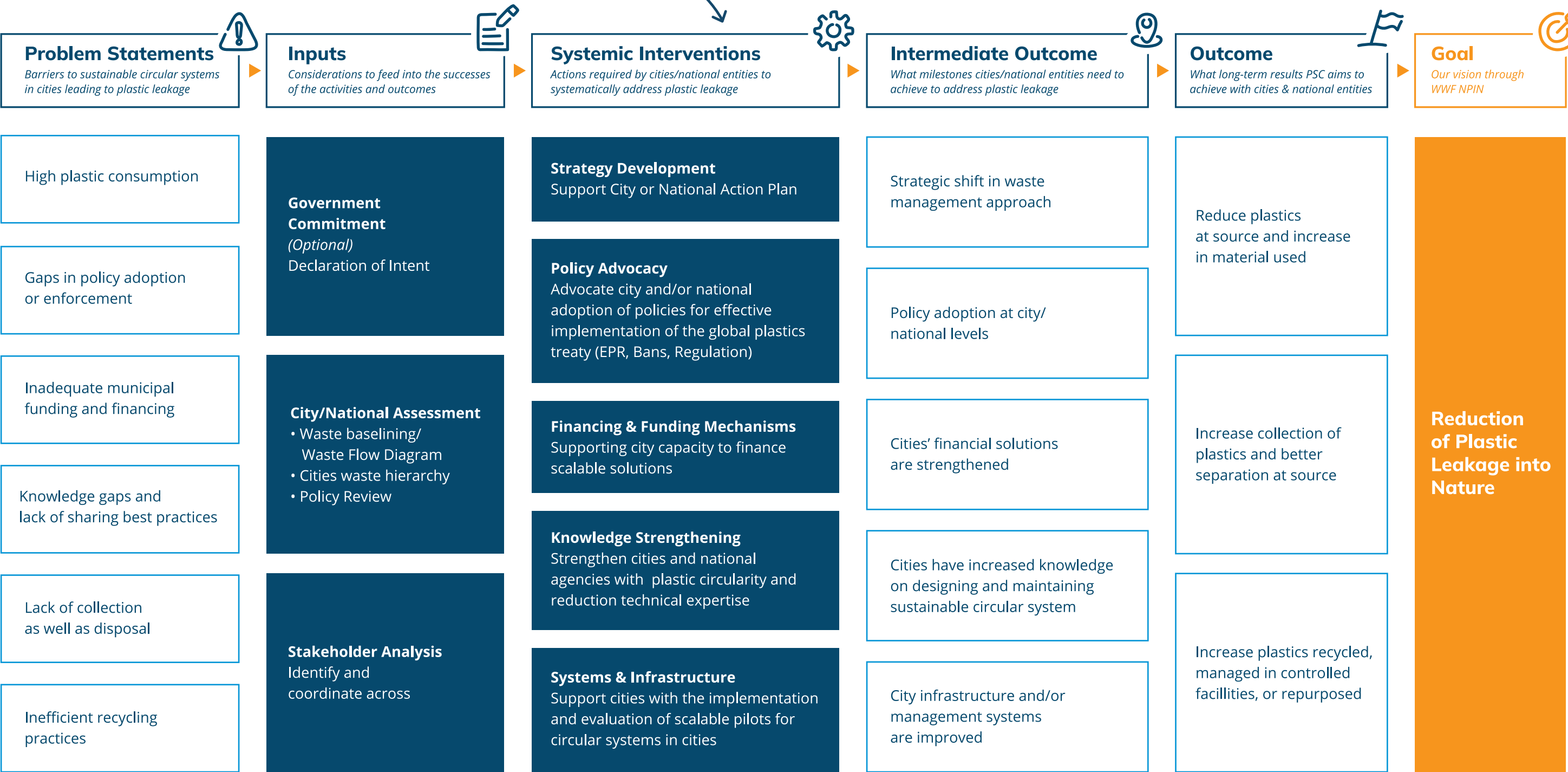
Chapter	PSC Approach	Number of Case Studies
 Reduction	Behavioural Change	3
	Reduction	2
	Reuse/Refill	1
 Collection	Collection and Separation	4
	Community-based Waste Management	4
 Recovery and Recycling	Recycling Facilities	5
 Enabling Framework	Local Policy and Regulation	1
	Sustainable Financing	1
	Monitoring and Assessment	2

Table 1. Summary of case studies presented in this report



☆ **PSC Theory of Change**

This study supports WWF's transition from a fixed city level approach towards systemic interventions, emphasising upstream solutions such as reduction, reuse, and enabling framework to reflect WWF PSC 2025 to 2030 Strategy. The strategy focuses on five key systemic interventions:



← towards sustainable circular systems →

Figure 1. PSC 2025 to 2030 Theory of Change



Reduction

1 Reduction

☆

Introduction

Sitting at the top of the waste hierarchy, waste reduction is considered the most vital solid waste management (SWM) option. Targeting interventions on preventing waste before it enters the system addresses plastic pollution upstream. Waste generation rates mostly depend on income-level, but this can also be influenced by socio-cultural patterns and climatic conditions (Kaza et al., 2018). Many interventions can support the reduction and prevention of waste generation, including policy instruments (e.g. extended producer responsibility (EPR)), awareness raising campaigns, SUP bans, and economic instruments (e.g. pay-as-you-throw).

With the ongoing global efforts for corporate net-zero, sustainable development goals, and the ambition of many countries towards a legally-binding Plastics Treaty, the trend in the 3R (reduce, reuse, recycle) is currently shifting towards ‘reduce and reuse’, and away from a reliance on ‘recycle’.

PSC has supported initiatives that promote waste reduction through behavioural change; business, school, and community engagement; and reuse and refill business models.

This chapter is made up of six case studies, shown in Table 2.



 Behavioural Change	 Reduction	 Reuse and Refill
Case Study Country (City/Site) 1.1 Zero Waste Schools in Indonesia Indonesia (Jakarta, Bogor, Depok) 1.2 Con Dao Schools Go Plastic-Free Viet Nam (Con Dao) 1.3 Pak Meng School Cashes in on Waste Thailand (Trang)	Case Study Country (City/Site) 1.4 Thailand’s Businesses Go Green Thailand (Songkhla, Hat Yai, Koh Samui, Surat Thani) 1.5 Hue Makes Tourism Sustainable Viet Nam (Hue)	Case Study Country (City/Site) 1.6 Choose to Reuse: Closing the Loop on Takeaway Packaging in Hong Kong China (Hong Kong SAR)

Table 2. Summary of case studies in the ‘Reduction’ stage



Summary

Reducing plastic waste requires behaviour change, business engagement, and reuse models. Schools in Indonesia, Viet Nam, and Thailand have effectively promoted waste reduction, separation and recycling through education, student leadership, and incentives. Business initiatives such as Thailand's PACT and Viet Nam's tourism models show that policy support and voluntary commitments can reduce single-use plastics, though funding and infrastructure remain challenges. Reuse systems, such as returnable packaging in Hong Kong, offer alternatives to disposables and need ongoing support to be sustainable.



Education and Behavioural Change

Achieving meaningful reduction depends on changing consumer behaviour, which involves developing sustained awareness campaigns, incentives, and policy support to maintain public engagement. Schools provide a structured environment where behavioural change interventions can be effectively tested and scaled. The school initiatives in Indonesia ([Case Study 1.1](#)), Viet Nam ([Case Study 1.2](#)), and Thailand ([Case Study 1.3](#)) demonstrate how targeted interventions – such as knowledge strengthening, student leadership, and incentive-based recycling – can successfully reduce waste, and increase waste collection for recovery and recycling. By integrating waste education into school curricula, launching recycling programmes, or organising beach clean-ups, these have instilled sustainable habits such as separating waste at source and recycling in students.



Business Engagement & Reduction

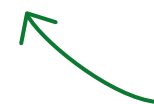
Engaging businesses is essential to reducing plastic waste at source. Initiatives focus on reducing the amount of plastic generated through policy measures (such as bans on single-use plastics), business-led voluntary commitments, and behavioural change campaigns. In Thailand, the [Plastic ACTion](#) (PACT) ([Case Study 1.4](#)) initiative encouraged over 67,000 businesses to reduce single-use plastics through opt-out mechanisms, commitments towards sustainable packaging, and centralised data tracking, supported by strong local leadership and private sector partnerships. In Viet Nam ([Case Study 1.5](#)), Hue's Plastic Waste Reduction Tourism Models engaged the provincial tourism department and over 40 businesses, installed refill infrastructure at tourist destinations backed by political endorsement and incentive mechanisms, though challenges remain with funding, infrastructure maintenance, and cost-effective alternatives.



Reuse and Refill

[Reuse and refill](#) models provide an alternative to disposable plastics by promoting systems where consumers can refill products in reusable containers. WWF-supported initiatives have included returnable packaging schemes (e.g. deposit return scheme) and reusable container-sharing models, as highlighted in Hong Kong ([Case Study 1.6](#)). These approaches demonstrate how businesses and consumers can transition away from single-use plastics (SUPs) and create a shared sense of action in tackling plastic waste reduction, despite remaining challenges in ensuring the sustainability of such reuse models.

Waste sorting
at school
in Indonesia



1.A

Education and Behavioural Change

Recommendations



National Government

Policy Development:

- **Integrate waste reduction & management into school curricula**, engaging students in active waste reduction to build long-term habits.
- Develop **age-appropriate environmental education** modules on waste reduction, recovery and recycling, and circular economy principles, making them part of standard lessons within existing school subjects.

Institutional Operations:

- Encourage system-level reform in school operations by integrating **green procurement policies** into national education frameworks.
- Require public schools to **prioritise sustainable purchasing practices** (e.g., reusable canteen ware, eco-friendly supplies, locally sourced materials, etc.) and reduce reliance on single-use plastics within school administration. Additional funding can be offered to schools to support this.

Staff Capacity Strengthening:

- **Provide training and resources** to ensure educators and/or school personnel can effectively deliver waste reduction, management, and sustainability topics in schools.

National Campaigns:

- Implement **national plastic-smart initiatives**, such as “Plastic-Free Schools” with clear guidelines and incentives for participation.



Local Government

Strategy Development

- **Develop locally tailored reduction strategies** to align with cultural norms, existing waste management infrastructure, and specific community challenges. Ensure that **initiatives benefit all community members**, including disadvantaged and marginalised groups (UN-Habitat, 2024).

Funding & Technical Support:

- Provide knowledge strengthening through **funding and technical support for local schools** to implement waste reduction programmes, such as composting and zero-waste initiatives.

Monitoring & Adaptation:

- Develop key performance indicators (**KPIs**) to **track progress of behavioural change** initiatives, conducting periodic assessments to ensure effectiveness and identify areas for improvement.



Table 1. Recommendations for reduction interventions

1.A

Education and Behavioural Change

Recommendations



Civil Society

Intervention Strategy:

- **Conduct campaigns and workshops** that build upon children’s knowledge using age-appropriate interactive methods such as **gamification, competitions, and student-led initiatives** to keep children engaged.
- Use **Participatory Action-Oriented Training (PAOT)** to improve waste management by expanding student leadership programmes, integrating hands-on learning (e.g., composting, waste audits, etc.). Engage parental and community involvement to further ensure long-term sustainability (WWF, 2024).
- **Enhance school-based waste reduction models** by implementing the “Plastic-Free Schools School” approach, promoting waste-free canteens, and encouraging student leadership through assigned “waste captains.”

Non-governmental Organisations (NGOs) /Community-based Organisations (CBOs):

- **Advocate for stronger government policies and regulation** to integrate environmental education into national curricula and school operations.
- **Provide schools with expert-led sessions** on waste reduction, circular economy principles, and sustainable practices.
- **Facilitate student-led initiatives and support clubs,** competitions, and projects that encourage students to take ownership of waste reduction and management solutions.
- **Bridge the gap between schools and waste collection/recycling companies,** ensuring waste does not end up in nature.
- **Engage students, parents, communities and local businesses** in activities that reinforce sustainable waste practices beyond the school.



Private Sector

Funding:

- **Develop Corporate Social Responsibility (CSR) Initiatives:** Businesses can fund and support school-based waste management programmes, including infrastructure (e.g., reuse/refill models, bins, composting systems) and educational materials.

Policy Support

- **Support local circular economy initiatives.** Businesses in packaging, retail, and manufacturing can promote reusable products from local produce and provide take-back schemes for recyclables.

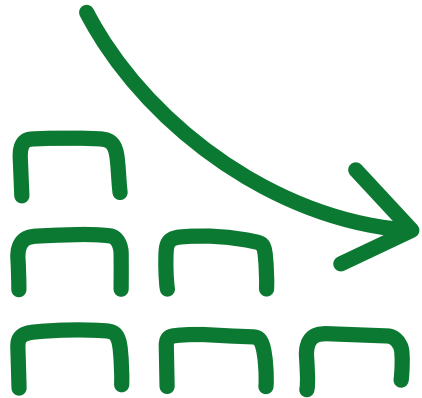
Incentives

- **Offer sponsorships and incentives:** Companies can provide rewards for schools excelling in waste reduction, such as scholarships, grants, or school improvements.

1.B

Business Engagement and Reduction

Recommendations



National Government

Policy Implementation:

- Create **enabling policies for reduction at source**. For example, develop and enforce EPR schemes that mandate businesses to reduce plastic packaging, improve recyclability, and take responsibility for post-consumer waste.
- **Align with global ambitions**, including the upcoming [UN Global Plastic Pollution Treaty](#), ensuring national commitments translate into concrete action at the local level.
- Develop national guidelines for **plastic-smart tourism** and integrate waste reduction targets into tourism policies and certifications.

Business Partnerships:

- Encourage public-private partnerships to **scale innovative business models** that focus on reuse and circular economy solutions.

National Campaigns:

- Establish **nationwide education campaigns** on waste reduction and initiatives such as “Plastic Smart Workplaces,” targeting businesses, consumers, and institutions to drive systemic behavioural change.

Monitoring and Assessing Data:

- Develop **national waste data reporting standards** that require businesses, municipalities, and producers to disclose plastic consumption and waste reduction efforts.
- Establish a **centralised digital waste monitoring** platform, allowing real-time data collection on plastic production, sales, recovery and recycling, and disposal.



Local Government

Policy Implementation:

- Create **enabling policies for reduction at source**.
- Enforce **local bans or restrictions on SUPs** in government offices, public institutions, and businesses, setting an example for the community.

Multi-Stakeholder Collaboration:

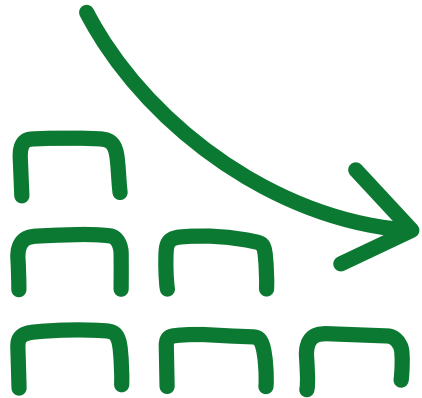
- Work with local businesses to initiate and **scale reduction and reuse initiatives**, providing incentives for refill stations, packaging return schemes, and alternative materials.
- **Engage CSOs and informal waste workers** in waste reduction programmes, ensuring inclusive and effective implementation.



1.B

Business Engagement and Reduction

Recommendations



Civil Society

Policy, Advocacy & Communications:

- **Encourage businesses to offer incentives** for customers who bring reusable containers or opt out of SUPs.
- **Strengthen consumer awareness and engagement through targeted communication strategies** that reinforce the benefits of reduction, making sustainable choices the default option.
- **Advocate for policy and regulations enforcing reduction efforts** and the power of youth-led advocacy in influencing decision-makers.



Private Sector

Policy Implementation:

- **Implement robust monitoring frameworks and economic incentives** for scaling plastic reduction efforts.
- **Align with reduction targets** set by local and national governments and report against progress on [CDP's disclosure platform](#).

Incentives:

- Drive change through **reward-based models and design** of customer-friendly alternatives.
- **Adopt the PACT approach** committing to plastic reduction efforts. For food delivery services, enable “opt-in” rather than “opt-out” options for utensils or packaging to further prevent the consumption of SUPs.



© WWF-Thailand

© Ecowastecoalition.blogspot.com

© Polina Tankilevitch / Pexels

1.C

Reuse and Refill

Recommendations



National Government

Mandates and Incentives:

- **Introduce mandatory reuse and refill targets** for businesses, particularly in sectors such as food and beverage, retail, and hospitality.
- **Incentivise EPR schemes** that prioritise reuse, requiring producers to take back and refill containers rather than relying on single-use packaging.
- **Provide grants and tax breaks** for small businesses investing in reuse systems.

Recognition:

- **Set up certification schemes** for businesses adopting reuse and refill models, making it easier for consumers to identify sustainable choices.

National Campaigns:

- Implement nationwide **public education campaigns** promoting refill and reuse habits, highlighting their environmental and economic benefits.



Private Sector

Redesign Business Models:

- **Prioritise reuse and refill systems and operations.** Work in partnership with consumers, NGOs, and local and national governments to implement and scale reuse systems.

Incentives:

- Create **incentives for consumers and business partners**, through discounts, loyalty points, or deposit refunds for customers using reusable containers.



Local Government

Business Engagement:

- **Integrate reuse and refill** into local business and waste policies. For example, require businesses to provide reusables for dine-in and takeaway food services, enforce local bans on SUPs, particularly for items such as plastic bags, cups, and cutlery.

City-Level Reuse Model:

- Apply the [Consumers Beyond Waste City Playbook](#) to adopt a ‘reuse city’ model.

Knowledge Sharing:

- **Engage in the Reuse Portal** to learn and share reuse solutions with other policymakers, businesses, CSOs, etc.



Civil Society

Policy, Advocacy & Communications:

- **Advocate for policy change and corporate accountability prioritising reuse over single-use packaging** and the monitoring of businesses, holding them accountable for sustainability commitments through transparency reports and watchdog initiatives.
- **Promote public awareness and consumer engagement.** Develop consumer-friendly resources including refill maps, directories of reuse-friendly businesses, and guides on sustainable consumption.

Knowledge Sharing:

- Engage in the [Reuse Portal](#) to learn and share reuse solutions with other policymakers, businesses, CSOs, etc.

Case Study 1.1



© WWF-Indonesia



Indonesia: Bogor, Depok, Jakarta

WWF Involvement: June 2022 to October 2024

Focus Area: Reduction

PSC Approach: Behavioural Change

Systemic Intervention:
Knowledge Strengthening



Key Lessons Learned

- **Creating plastic-free canteens supports measurable waste reduction:** The move to reusable containers and requiring vendors to manage their own waste led to a notable reduction in plastic waste, showing the value of involving all food service actors.
- **Zero-Waste Schools simplifies waste management systems:** Focusing waste streams on organic, paper, and cardboard made school operations more manageable and reduced the need for additional separation at source bins.
- **Empowering student leaders nurtures ownership and participation:** Assigning “waste captains” promotes peer involvement and personal responsibility, contributing to the initiative’s success.
- **Embedding education and engagement allows for long-term impact:** Ongoing environmental education for students, teachers, and parents helped create a shared commitment to zero-waste goals.
- **Reinforcing take-home policies can help reduce plastic on-site:** Encouraging students to bring plastic waste home helped minimise waste accumulation at school, although it highlights the importance of continued guidance to ensure proper disposal at home.



Background

In 2022, the PSC [Zero Waste School](#) initiative was launched by WWF-Indonesia in three pilot public schools located within the Ciliwung River Basin, which runs through Jakarta, Bogor, and Depok. The programme focuses on elementary and junior high schools to instill sustainable habits from a young age.

One of these schools is in Jakarta, and is officially designated as a [Net Zero Carbon School](#), awarded by the [Green Building](#)

[Council Indonesia](#), as part of the city’s goal to achieve Net Zero Emissions by 2050. This school requires students to take plastic waste home, preventing waste accumulating in school. In principle, no waste is generated in the school – organic waste from the grounds is composted on-site, a plastic-free canteen is employed where students bring reusable lunch boxes and cutlery to minimise waste. The school aims for zero plastic waste and has implemented a “No Plastic” campaign reinforcing these habits.

The school earned a Greenship award (2022) for Net Zero Health for energy efficiency (saving 30,000 watts/day of electricity using solar panels), carbon balance, and health and comfort. Their recently installed hydroponics system provides hands-on agricultural education, while the fish habitats around the school help control mosquito population. This model has inspired other schools to replicate the model, demonstrating its impact and scalability.



Objectives

- Implement a comprehensive net-zero waste programme, including waste separation, composting, and energy efficiency measures.

Key Successes

- **Plastic-free canteen:** The school eliminated single-use plastic by enforcing reusable lunch boxes and cutlery, reducing waste. Any leftover food was given back to the external food vendors to dispose offsite.
- **There is minimal waste generation,** so only two source separation bins are necessary (organic and paper). Organic, paper and cardboard waste are composted, recycled or used in upcycling projects – where students transform paper and cardboard waste into culturally significant artwork, preserving and celebrating their heritage.

- **Student empowerment:** A rotating “captain of the day” system encourages students to oversee waste management, instilling responsibility.
- **Integration of zero waste and environmental education** into the school curriculum, ensuring long-term impact.

Key Challenges

- **Continued education and reminders** are required amongst students to sustain consistency and proper disposal practices.
- **Controlling plastic packaging from external food vendors:** Although plastic use is banned inside the school, students purchase food wrapped in plastic from outside sources.
- **Take-home plastic waste policies reduce accumulation at school** but present risks if not paired with adequate disposal education. There is a chance that, without proper supervision, plastic waste may be discarded improperly once offsite.
- **Visitor compliance with zero-waste rules** requires active monitoring, as frequent visits from external guests and stakeholders introduce an added layer of complexity in maintaining a fully zero-waste environment, requiring continued oversight.

Resources

Support: WWF’s role was to connect the school with the Ministry of Education, providing technical support, best practices, and teacher training on waste management and

environmental education. Additionally, WWF’s Panda Mobile, a mobile education unit, visited the schools, engaging students through interactive storytelling, games, and craft workshops, making waste management and sustainability education both fun and impactful. The Jakarta Provincial Government provided an estimated 1.6 billion Indonesian Rupiah (around USD 110,000) for operational expenses and maintenance for SDN Ragunan 08 school, including the provision of solar panels.

Infrastructure: The school relies on contracted food vendors who are responsible for taking their waste back with them. Furthermore, an onsite composting area processes organic waste, including shredded leaves and plant debris, using a one tonne/day leaf shredder.

Enabling Factors

- **Government funding played a key role in enabling early implementation:** Support provided to pilot schools allowed for successful demonstration of the model. However, schools with fewer resources may benefit from additional external funding or policy-level support to adopt similar approaches.

Risks & Opportunities

- **Teacher and student engagement:** Long-term success depends on consistent training and engagement, requiring ongoing curriculum integration.
- **Knowledge exchange for scaling:** experience sharing with other schools and advocacy to implement or mandate the “Zero Waste School” program nationally.

Case Study 1.2



Viet Nam: Con Dao

WWF Involvement: March 2021 to May 2024

Focus Area: Reduction

PSC Approach: Behavioural Change

Systemic Intervention:
Policy Advocacy, Knowledge Strengthening



Key Lessons Learned

- **Cross-sectoral collaboration enhances scalability and policy uptake for educational activities and plastic waste reduction:** Strong partnerships between government agencies, schools, and a private sector recycler enabled the “Plastic-Free School” model to be adopted across all six schools on the island, supporting long-term sustainability and institutional integration.
- **Addressing local infrastructure gaps requires external support and coordination:** The absence of local recycling facilities, as is usual on small islands, highlighted the importance of working with mainland partners, such as Circular Action Viet Nam, to establish waste management solutions in geographically isolated areas.

Con Dao Schools Go Plastic-Free



Background

Con Dao, like many islands and coastal areas that are relatively small and remote, face unique challenges with waste management. This is due to limited recycling infrastructure and its geographic location that make it susceptible to plastic pollution from marine and land-based activities. Recognising the need for long-term solutions, The People’s Committee integrated plastic waste awareness and reduction into teaching materials and teacher training, across all six schools on the island from kindergarten (3) to primary (1), secondary (1), and high school (1).

In response, the Department of Natural Resources and Environment, and the Department of Education and Training launched a large-scale teacher training initiative, equipping 180 teachers from six schools with the knowledge to implement the Plastic-Free Schools model.

The programme introduced waste reduction and recycling initiatives in schools, focusing on reducing SUPs, promoting waste sorting, and establishing systems for recyclable materials such as milk cartons. These cartons are multi-

layered plastic materials, making them more challenging to recycle and requiring specialised processing solutions.

Objectives

- Embed plastic waste education into school programmes.
- Implement the Plastic-Free School model across Con Dao
- Reduce single-use plastics through awareness, regulations, and infrastructure.
- Establish a recycling system for key waste streams such as milk cartons and food packaging waste.

 Key Successes

Expansion of the [Plastic-Free School Model](#)

- In 2021, three kindergartens piloted **WWF-Viet Nam’s plastic waste free school model** which involved replacing single-use plastics with reusable bags and cutlery, establishing a waste collection and recycling programme for old toys, and raising awareness amongst students, teachers, and parents on sorting and reuse, as well as holding Plastic Recycling Festivals.
- The one primary school then introduced the **Plastic Reduction Model** between 2022 to 2023, which included SUP reduction, sorting and recycling activities. They also established regulations and action plans for sorting and the reduction of SUPs in collaboration with the secondary and high schools, and launched a [milk carton recycling programme](#) with a recycling company, Circular Action Viet Nam. The programme collected 141,280 milk cartons (one tonne) in one year.
- The secondary school led oratory **competitions on plastic waste**, school-wide plastic bans, and waste sorting competitions, cutting plastic waste by 71%, nearly eliminating disposable plastic cutlery. Sustaining and improving this progress requires ongoing behavioural enforcement to ensure lasting change.
- The high school reformed their canteen and created **student-led waste monitoring teams** to improve compliance with waste reduction policies.

 Key Challenges

- **Local recycling infrastructure constraints:** In the absence of on-island recycling facilities, schools rely on mainland organisations such as [Circular Action Viet Nam](#) to manage collected recyclables. This approach

has required additional resources, coordination, and logistical efforts from school staff alongside their existing responsibilities.

- **Maintaining long-term behaviour change:** While early engagement from students and teachers was encouraging, sustaining commitment to waste reduction and sorting practices over time requires continued reinforcement through education, monitoring, and targeted incentives.

 Resources

Support: WWF connected the school to local government, having a supporting and capacity-building role by introducing the plastic free model, developing training materials, and co-creating and implementing the schools’ action plans.

Human Resources: 180 teachers trained by the Department of Education and Training facilitated student engagement and programme implementation.

Stakeholders: Department of Education and Training, Department of Natural Resources and Environment, Con Dao Youth Union (a partner in the project who organised the milk carton collection), [Circular Action Viet Nam](#) (recycling partner).

Infrastructure: Schools developed structured waste management action plans, introduced different coloured separation bins, increasing sorting efficiency, and issued the regulation of SUPs reduction in schools, especially in canteens, and displayed posters communicating the message “No single-use plastic in the school” to prompt and support behavioural change and reduce plastic consumption.

 Enabling Factors

- **Policy support:** Government commitment to integrating environmental education into school curricula and the endorsement of the Plastic-Free School model provided a strong foundation for project implementation across all six schools on Con Dao Island.
- **School engagement:** Teachers played a key role in shaping student behaviour, while community involvement through competitions, awareness campaigns, and incentive-based activities further supported behavioural change.
- **Public-private collaboration:** Partnerships with recycling and waste management organisations helped ensure that collected waste was appropriately handled and processed.

 Risks & Opportunities

- **Reliance on external partners:** The initiative relies on collaboration with one mainland recycling partner. Disruption to this relationship could affect the continuity of recycling activities and pose challenges for long-term sustainability. Diversifying partners would support continuity.
- **Variability in community engagement:** The effectiveness of the waste separation and recycling efforts may depend on active and sustained involvement from students, teachers, and parents.
- **Knowledge exchange for scaling:** experience sharing with other schools and advocacy to further scale Plastic-Free Schools nationally or in islands of similar contexts.

Case Study 1.3





Thailand: Trang City, Trang Province

WWF Involvement: January 2023 to March 2025

Focus Area: Reduction, Collection

PSC Approach: Behavioural Change, Community-based Waste Management

Systemic Intervention: Knowledge Strengthening, Systems & Infrastructure

Key Lessons Learned

- Regular monitoring ensures long-term results:** Establishing regular check-ins by a dedicated local team every two to three months (as recommended by [Tide Ocean](#)) may help reinforce best practices, maintain engagement, and gently encourage ongoing improvements beyond occasional plastic-related workshops alone.
- Designing curricula that aligns with student comprehension boosts participation:** Designing school curricula to closely match students' age and comprehension levels, and including interactive or game-like elements, can help maintain student interest and encourage more active involvement.
- Offering financial incentives may positively influence student participation and healthy competition:** Providing opportunities for students to earn small financial rewards through partnerships with waste banks and junkshops can encourage sustained participation in recycling activities and promote friendly competition.
- Engaging parents and the community amplifies behavioural change beyond school:** Extending outreach to parents and community members through targeted educational campaigns and financial incentives can reinforce students' waste management behaviours at home, promoting broader and lasting behavioural change.

 Background

Pak Meng School in Trang, Thailand, piloted a holistic approach to plastic waste management from initiating educational activities for the reduction of plastic usage to installing a waste bank system. WWF-Thailand launched this project to provide technical expertise on project design and implementation, while Tide Ocean (a recycler) and PreZero International also partnered with WWF, leading on the implementation of educational workshops on plastic pollution's impact on marine ecosystems. WWF supported

the school with establishing partnerships with junkshops, creating a structured system that motivated students to engage in waste separation. This included implementing waste separation bins and a composting area with the aim to instil waste management habits in young students by incorporating hands-on activities and financial incentives.

Objectives

- Enhance student awareness of marine plastic pollution and the importance of waste reduction through interactive workshops and beach clean-ups.
- Improve waste practices at the school through separation at source, recycling practices, and reducing plastic pollution from the school grounds.
- Provide access to a waste bank and junkshops where students could sell recyclables for financial rewards.

 Key Successes

- **Educational Workshops:** students initially were unaware of how to separate waste for recycling, but learned to do this with the provision of waste separation bins and practical workshops. Reusable bags and mugs were also provided to students during the workshops with the intention to reduce the use of plastic bags and bottles, which students could use at a water refill station that was provided by Tide Ocean.
- **Waste bank and student incentives:** A waste bank was implemented at the school, where students opened accounts to track their disposal efforts. Each time a student correctly disposes of recyclables, their contribution is logged. Prizes and financial rewards are given to students based on their participation level.
- **Junkshop partnership:** Every two to three months, a junkshop visits the school to purchase recyclables, buying PET and glass bottles, paper, cardboard, and steel. Students directly earn money from the junkshop for their recyclables – 10 THB/kg (0.30 USD/kg) – with the highest earners receiving prizes from the school, creating healthy competition among students. The school collects around 90 tonnes of plastic waste each year.
- **Organic waste management:** Food waste is regularly collected and donated to local farms for animal feed, reducing landfill waste. To promote repurposing, students also engage in paper mâché projects, creatively repurposing old homework into new materials. The amount of scattered waste throughout the school has significantly decreased since the programme’s start.

 Key Challenges

- **Plastic Pollution Curriculum:** while Tide Ocean developed a school curriculum on plastic waste, integrating it into existing school subjects presented challenges due to existing demands of the curriculum and that some of the content was not fully aligned with student comprehension levels, resulting in educational activities limited to the workshops.
- **Waste Segregation:** Having multiple waste separation bins helped to generate interest and engagement in waste separation, however, there is room for greater consistency in practice to improve the quality of the organic waste and use of the composting facility.
- **Community Support:** there was a gap in parental awareness of waste management, which made it more difficult for students to maintain consistent practices outside of school.
- **Space Constraints:** The low frequency of junk shop visits (every 2–3 months) required for adequate space and organisation for storage.
- **Weekly beach clean-ups:** were initially carried out by students, but due to challenges in managing large groups, they were later adapted into monthly activities through a supervised volunteering initiative.
- **Staff Turnover:** knowledge retention was affected by frequent staff changes, making it more difficult to consistently access the right information.

 Resources

Stakeholders and infrastructure: Tide Ocean led three capacity building workshops on plastic pollution for Pak Meng School. Activities included painting reusable cloth bags and

mugs, playing educational games, and creating an activity book for the children. They developed a school curriculum on plastic waste, provided a water refill station, waste separation bins, and reusable bags. Other activities held by WWF included a workshop on plastic pollution’s impact on marine ecosystems, waste collection, beach cleanups, and additional educational workshops. Five separation at source bins were introduced alongside training for school personnel and students.

Human resources: 18 teachers were trained by Tide Ocean and who educated 240 students about waste management.

 Enabling Factors

- **Financial incentives:** The combined model of a waste bank and junkshop partnership was useful in supporting participation and behaviour change through structured reward systems.

 Risks & Opportunities

- **Sustaining long-term enthusiasm** and engagement among students and households requires ongoing effort and to be continued.
- **Dependence on external funding and support:** Without continued input from consultants or business partners, maintaining certain components – such as the waste bank and educational workshops – may pose challenges over the long term due to financial constraints and maintaining efforts.
- **Embedding this waste bank into school operations** would support sustainability of the initiative.

Case Study 1.4





Thailand: Hat Yai, Koh Samui, Songkhla, Surat Thani

WWF Involvement: March 2024 to December 2024

Focus Area: Reduction

PSC Approach: Reduction and Reuse/Refill

Systemic Intervention: Knowledge Strengthening

Key Lessons Learned

- Consistent and targeted communication to increase customer engagement:** Clear, ongoing communication that addresses both long-standing and new customers helps businesses effectively convey the purpose and benefits of PACT initiatives, while navigating varied customer expectations.
- Highlighting cost savings and market benefits drives business participation:** Businesses are more likely to join and remain committed to PACT when tangible operational cost reductions and additional market advantages, such as enhanced tourism appeal and increased customer satisfaction, are evident.
- Consumer preferences significantly influence adoption of sustainable practices:** Eco-conscious customers actively reinforce businesses' commitments by consistently choosing sustainable options. However, continued consumer awareness efforts are still very much needed.
- Strong local leadership and community engagement increases programme effectiveness:** Local governments play a vital role in connecting businesses to PACT initiatives, while effective leadership from trusted community figures – with strong communication skills and the ability to build relationships – highlights deeper commitment and stakeholder buy-in.
- Continuous consultation and peer learning enhances long-term business commitment:** Regular opportunities for experience-sharing, ongoing workshops, and practical demonstrations encourage businesses to remain engaged and consistently implement plastic waste reduction strategies.

Background

WWF's Plastic ACTION (PACT) is a business initiative that aims to reduce waste and move towards a circular economy. The programme empowers companies to adapt their business models and processes to be more resource efficient, as WWF facilitates the coordination of the businesses in the HORECA (hotels, restaurants, cafes) sector and takeaway platforms. The PSC project further contributed to raise awareness among tourists, residents, youth, and business owners.

In 2020, the Plastic Institute of Thailand estimated that 36% of the 9 million tonnes of plastics produced annually are single-use plastics (SUP) (EJF, 2024), 15% of which ends up in the environment, having a negative impact on the natural ecosystem and the tourism industry. To tackle the use of SUP in the hospitality sector, WWF-Thailand piloted the PACT initiative with 38 local businesses in Koh Samui, Songkhla, Surat Thani and Hat Yai. Specifically service providers, such as food delivery companies, which influences consumers

and merchants across the country. These platforms have actively contributed to the PACT initiative through business partnerships by implementing several key strategies as follows:

- Reduction of SUPs:** The companies have introduced an “opt-out” feature for plastic cutlery in their applications, encouraging customers to decline unnecessary utensils.

- **Promotion of sustainable materials:** They are advocating for the use of eco-friendly and reusable packaging among their partner restaurants and are collaborating with major packaging suppliers to facilitate this transition.
- **Information sharing and best practices:** These service providers are sharing relevant information, case studies, policies, and best practices to facilitate business transition toward circularity.

Objectives

- Encourage businesses to adopt eco-friendly business models.
- Promote consumer behaviour changes to reduce SUP packaging.
- Provide businesses with tailored monitoring and evaluation tools and training, communication for behavioural change, guidance, best practices, and network building among stakeholders in the value chain.

Key Successes

- In one month, **10,000 applications were received** from businesses throughout Thailand to join PACT for alternative plastic packaging materials.
- Between April and December 2024, **67,000 businesses have joined PACT** through [LINEMAN Wongnai](#), contributing to a reduction of an estimated 33 tonnes of SUPs.

Key Challenges

- **Business engagement:** Some businesses were initially hesitant to join the PACT campaign, particularly where awareness of sustainability practices or environmental commitments was still emerging.
- **Customer engagement:** Certain customers expressed dissatisfaction when single-use plastics were not readily available, especially where convenience or hygiene was a concern.
- **Municipal engagement:** Municipalities demonstrate varying levels of engagement with plastic reduction efforts. Where municipal leadership is more proactive – such as in Surat Thani – positive outcomes have been observed through stronger collaboration with the HORECA sector.
- **Financial costs for SUP alternatives:** The cost of sustainable packaging can be a barrier. For example, sugarcane bagasse containers for takeaway meals typically cost THB 3 to 6 per unit, compared to THB 1.5 to 2.5 for conventional SUP equivalents.
- **Additional human resource needs:** For businesses shifting to reusable alternatives, staff must manage regular washing cycles. During peak customer periods, maintaining this system can be challenging, potentially leading some businesses to revert to SUPs when under pressure.
- **Need for consistent communication:** Businesses often need to balance the expectations of long-standing customers with those of new ones. Some returning customers may feel uncertain about changes, while new customers may respond more positively to sustainability practices.



 Resources

Partnerships: [LINEMAN Wongnai](#), [foodpanda](#) (major food delivery platforms) and [CaneX Bio-Packaging](#) (supplier of sustainable packaging solutions).

 Enabling Factors

- **Political endorsement:** Visible municipal support and recognition of PACT commitments create a sense of shared responsibility among partners and help reinforce their dedication to plastic waste reduction, encouraging wider participation.
- **Partnerships with the private sector:** The broad reach of the PACT initiative has been made possible through close collaboration with private sector actors, such as food delivery platforms and packaging suppliers.
- **Rising consumer awareness:** Increasing awareness among business owners and consumers about alternatives to SUPs has played a key role in accelerating adoption of sustainable practices across Thailand.

 Risks & Opportunities

- **Affordability of alternatives:** Alternatives to single-use plastics often come at a higher cost to businesses as well as consumers. Without ongoing financial or regulatory support, some businesses may struggle to maintain participation. Businesses could engage as a group to align on reuse or alternative materials, potentially lowering costs.
- **Greenwashing risks:** Some companies may appear to support sustainability while continuing unsustainable practices. As consumers become more environmentally aware, misleading claims could undermine trust and slow progress toward genuine plastic waste reduction. Alternative materials should be carefully considered by businesses to ensure there are no additional harmful environmental impacts.

For more information on PACT and for contact details to join the initiative, visit the [PACT website](#).



commitment to reduce single-use plastic in Thailand with PACT



Case Study 1.5



Viet Nam: Hue

WWF Involvement: November 2021 to December 2024

Focus Area: Reduction

PSC Approach: Reduction; Reuse/Refill

Systemic Intervention:
Knowledge Strengthening



Key Lessons Learned

Hue Makes Tourism Sustainable

- **Economic incentives support long-term success:** Securing financial commitments from stakeholders, including government agencies and the private sector, helps ensure sustainability over time.
- **Practical and affordable alternatives facilitate wider adoption of sustainable practices:** Businesses are more inclined to shift toward sustainable practices when cost-effective and practical alternatives to SUPs are readily available. Demonstrating successful case studies and best practices further builds confidence among businesses and encourages broader uptake.
- **Maintaining public infrastructure:** Public awareness campaigns accompanying infrastructure installations encourage correct usage and ongoing maintenance. Clearly defined management responsibilities and

consistent funding for the upkeep of infrastructure—such as water refill stations—are important for ensuring lasting operational effectiveness.

- **Reliable impact measurement strengthens scalability and stakeholder confidence:** Implementing robust monitoring frameworks that accurately measure plastic waste reduction can refine strategies and support informed decision-making. Data-driven insights clearly demonstrate effectiveness, encouraging stakeholders to support and replicate successful models.



Background

According to the 2021 baseline assessment carried out by WWF in Hue city, 15% of the total waste generated in the city was plastics (60 tonnes/day). The assessment also highlighted interventions to improve the overall SWM system (WWF , 2024e).

Since 2022, PSC in Hue has worked at the provincial level with Thua Thien Hue Province Tourism Department and Association to promote the reduction of SUP in the tourism

sector. The programme supported the development and implementation of several Plastic Waste Reduction Tourism Models: a community-based Tourist Destination Model in Thuy Bieu Village, a Plastic Waste Reduction Hotel Model, and a Pilot Model for Teaching and Training a Plastic Waste Reduction-Oriented Workforce.

Objectives

- Educate and engage tourism businesses in implementing business practices, such as reducing the use of SUP.

Key Successes

- **Pro-active engagement** from Thua Thien Hue Province Tourism Department and Association.
- Over **40 tourism businesses**, including hotels, tour companies, and restaurants have signed a commitment to implement plastic waste reduction in their operations. In the first three months of 2024, four partnered tour companies reduced more than 3,300 water bottles.
- Nine tourist destinations in Hue city have **installed water refill stations**, including the Thien Mu Pagoda, Bao Vinh Ancient Town, Half-Moon Bridge, Vong Canh Hill, and Sinh Village.
- 12 hotels have developed and are **implementing a grassroots plastic reduction plan**.

Key Challenges

- **Financial constraints in reducing SUPs:** Businesses may face challenges in transitioning away from SUPs due to the relatively high cost of sustainable alternatives. Without access to financial incentives or external funding, many hesitate to adopt environmentally friendly practices.
- **Business engagement remains a work in progress:** Many businesses are still navigating how to align plastic waste reduction efforts with their operational and financial priorities. The availability of economically viable alternatives that meet business needs continues to evolve, and finding the right balance between environmental goals and profitability remains an ongoing consideration.
- **Sustaining public water refill stations presents operational considerations:** Public water refill stations and waiting areas at tourist sites have experienced wear and tear, influenced in part by varying levels of

public understanding regarding shared resource care. Ensuring consistent funding for ongoing maintenance and operations is also important to support long-term effectiveness and the potential for broader replication.

- **Assessing long-term impact is still evolving:** The contribution of these initiatives to overall plastic waste reduction is not yet fully clear, as existing monitoring is based on peak-week observations (i.e. weeks where the most waste is generated). Broader data collection would support a more complete understanding of progress over time.

Resources

Support: WWF supported collaboration between all stakeholders and ensured political buy-in. They provided equipment and facilities for Hue City to promote the efficiency of waste collection and separation at source.

Partners: Thua Thien Hue Province Tourism Department and Association, Party Committee of Hue City, Community Tourism Sub-Association, Green Park Centre’s Hue City People’s Committee, Hương Vinh Ward People’s Committee, Phu Mau Commune People’s Committee, travel tour agencies, hotels, and restaurants.



Enabling Factors

- **Political endorsement:** A clear showcase from the municipality’s support and recognition of the city’s commitments to tackle tourism waste encourages a sense of moral value among the partners but also reinforces their dedication to reducing plastic waste and inspires others to join the initiative.
- **Increased awareness:** The growing awareness from business owners and consumers of the negative impacts of plastic waste can help ensure they remain committed to plastic waste reduction.
- **Demonstrated success:** Potential new partners are more likely to shift their business models if successful experiences can be demonstrated.

Risks & Opportunities

- **Availability of cost-effective alternatives:** Alternatives to SUP tend to be more costly for businesses. If financial incentives or regulatory pressure decrease, corporate participation may be affected over time. Businesses and the tourism department could collaborate with one another on reuse models or bulk purchases of alternative materials to lower costs.
- **Scaling nationally** by replicating the model with other provincial tourism departments and businesses could increase the impact of this initiative.

Read more about this model here: [The Plastic Reduction Journey of Hue City](#)

Case Study 1.6



China: Hong Kong SAR

WWF Involvement: September 2022 to August 2024

Focus Area: Reduction

PSC Approach: Reuse and Refill

Systemic Intervention: Knowledge Strengthening



Key Lessons Learned

Choose to Reuse: Closing the Loop on Takeaway Packaging in Hong Kong

- **Reusable packaging systems require strong incentives and operational support:** The initiative successfully piloted a closed-loop reusable container system, with over 27,300 containers borrowed and 17,000 orders placed. However, experiences from implementation highlighted some logistical complexities, a relatively modest return rate (~45%) for considerable setup and operational costs. While initial outcomes are promising, addressing these practical considerations could further strengthen future implementations.
- **Well-structured consumer incentives significantly improve reusable packaging returns:** Encouraging reusable packaging in the food delivery sector benefits from carefully designed incentives, such as monetary deposits or discounts. Although a relatively modest

deposit (HKD 10 or USD 1.25) encouraged consumer participation, return rates remained around 45%. Adjusting financial incentives and aligning return processes more closely with consumer habits may further improve overall system efficiency.

- **Convenience and product variety directly influence consumer adoption of reuse systems:** Smaller menu options for reusable packaging among participating restaurants affected consumer participation, highlighting that ease of access and a broader variety of choices play an important role in the success of reusable packaging initiatives.



Background

Hong Kong has faced growing plastic pollution challenges, exacerbated by the increasing popularity of food delivery services. The surge in SUP packaging, particularly during the COVID-19 pandemic, highlighted the urgent need for sustainable alternatives. In response, WWF-Hong Kong partnered with [foodpanda](#) Hong Kong to introduce a closed-loop reusable container system for delivery and takeaway meals.

This initiative aligns with Hong Kong's Waste Blueprint for 2035 (Environment Bureau, 2021) and supports the PSC approach, both aimed at reducing plastic waste and promoting sustainable urban solutions.

Objectives

- Enhance consumer awareness regarding reusable food packaging.
- Promote behavioural shifts to reduce reliance on SUP.
- Develop a scalable logistics model for reusable food containers.
- Encourage the food and beverage industry to adopt sustainable packaging solutions.

 Key Successes

- **Strong adoption and participation:** More than 27,300 reusable containers were dispatched to customers between October 2022 and July 2024, with over 17,000 food orders placed using reusable packaging. The initiative engaged over 80 restaurant partners and reached more than 15,400 consumers, with a 25% monthly re-order rate, indicating repeat user engagement.
- **Expansion of infrastructure and logistics:** The project started with nine collection machines in high-foot traffic areas and later expanded to 12 locations, covering a 6 to 7 km radius. Reverse vending machines were integrated with the city's Octopus e-payment system, making deposit refunds seamless. Partnerships with nine property developers and the MTR Corporation enabled strategic placement of collection points.
- **Effective awareness campaigns:** Exposure via foodpanda channels, as well as advertisements at MTR stations, and commercial buildings helped raise awareness. Public and corporate workshops, along with collaborations with influencers and environmental advocates, played a key role in increasing consumer interest. The initiative is also aligned with the Sustainable Restaurant Certification Scheme to promote adoption among businesses.

 Key Challenges

- **Engagement levels evolved over time:** While initial participation was strong, engagement began to taper after six months. This shift appeared to be influenced by challenges in expanding restaurant involvement, a more limited selection of menu offerings, and reduced visibility on the delivery platform.

- **Return rates were lower than initially anticipated:** The use of a HKD 10 deposit provided some incentive for returns; however, it was not always sufficient to encourage timely container recycling. Although foodpanda offered incentives to couriers to support returns, some users preferred to return containers in bulk or chose to retain them for personal use, which impacted overall return rates.
- **Sustaining financial viability required ongoing investment:** The initiative involved costs across several operational areas, including logistics, industrial cleaning, marketing, and container maintenance. In the absence of regulatory incentives or external subsidies, maintaining these functions presented considerations for long-term scalability and financial sustainability.

 Resources

Support: Together with [foodpanda](#) Hong Kong, WWF led stakeholder engagement, project coordination, and public outreach, with the objective of integrating reusable packaging into the food delivery system. WWF secured financial support through the [Environment and Conservation Fund](#) (ECF) and ran awareness campaigns to drive consumer and business participation. The initiative's setup and operational costs included USD 5,000 per collection machine, with a monthly rental fee of USD 450 per location. Logistics for cleaning and transportation totalled USD 10,000 per month, while reusable containers were procured at USD 2 per unit, with contingency stock to maintain availability.

Stakeholders: Financial backing from the ECF, WWF partnered with [foodpanda](#) Hong Kong and over 80 restaurant partners, as well as property developers and the [Mass Transit Railway \(MTR\)](#). Logistics and cleaning operations were managed by [The Society of Rehabilitation and Crime](#)

[Prevention \(SRACP\)](#)'s social enterprise, [Bright Services Co. Ltd.](#), while [Gategroup Solutions Hong Kong Limited](#) managed sanitisation and redistribution, ensuring a seamless return process.

Human resources: A part-time WWF project manager oversaw implementation, logistics, and stakeholder coordination. Additional support staff were assigned by foodpanda to manage operations, customer engagement, and container collection at return stations.

 Enabling Factors

- **User-friendly system:** Return stations are simple, intuitive and easily accessible to encourage participation.
- **Strategic machine placement:** Locations with high foot traffic, such as transit hubs and office complexes, ensured better return rates.

 Risks & Opportunities

- **Scaling efficiency:** Some restaurants and food delivery platforms may be hesitant to adopt reusable systems due to perceived complexity and limited short-term financial returns. Stronger reuse policy could see reuse systems to be adopted more widely to ensure financial sustainability due to the model's dependence on economies of scale.
- **Sustaining public engagement:** Ongoing consumer participation may require continuous investment in marketing and education efforts by both local governments and private sectors.



2



Collection

2 Collection

Introduction

Waste collection is a basic service that about two billion people globally still do not have access to (Kaza et al., 2018). Providing a reliable, robust and universal collection service will help to protect public health by combatting open dumping, burning, and plastic leakage from uncollected waste. Plastic Smart Cities have worked on two levels to improve waste capture, particularly in underserved areas, through community-based waste management models and formalised collection systems.

Formal collection systems supported by PSC interventions focus on expanding waste collection services, improving logistics, and integrating digital tools to enhance efficiency. In several cities, innovative aggregator apps have been introduced to connect households with waste collectors, improving waste collection rates.

Community-based waste management empowers local groups, including waste banks, neighbourhood associations, and informal waste workers, to set up localised initiatives. These models have emerged due to limited basic waste services. Highly populated peri-urban areas, economically challenged and informal settlements, and remote rural communities are most affected by a lack of regular and reliable collection service. Incentives are sometimes offered, where residents can exchange segregated recyclables for financial or in-kind rewards, introducing the role of waste banks.

This section presents eight case studies, shown in Table 3.

Collection and Separation	Community-based Waste Management
Case Study Country (City/Site) 2.1 Household Waste Separation at Source in Tan An Viet Nam (Long An) 2.2 Expanded Waste Collection in Phu Quoc Viet Nam (Phu Quoc) 2.3 Boosting Collection in Manila with Blockchain Technology Philippines (Manila City) 2.4 Hat Yai's Mall Take-Back Programme Thailand (Hat Yai)	Case Study Country (City/Site) 2.5 Surat Thani's Pathway to Waste Bank Success Thailand (Surat Thani) 2.6 Kenanga Waste Bank: Building an Integrated System in Bogor Indonesia (Bogor) 2.7 Rumah Harum: The Last Centralised Waste Bank of Depok Indonesia (Depok) 2.8 Songkhla's Fisherman Reel in Waste Thailand (Songkhla)

Table 3. Summary of case studies in the 'Collection' stage



Summary

The success and sustainability of waste collection initiatives depend on a combination of community engagement, policy support, financial viability, and effective system integration. As highlighted throughout this chapter, expanding collection coverage requires extensive efforts, which need both formalised waste management systems and community-led solutions, particularly in underserved and marginalised areas.



Collection and Separation

Collection systems that ensure clean, well-separated recyclables are crucial for attracting reliable off-takers (e.g., recyclers or manufacturers). Encouraging separation at source helps produce higher-value outputs, which strengthen the overall regional plastic supply chain. Separation at source is the most effective way to improve the quality of recyclables, which is often facilitated through community-based waste management and (at least) a dual-stream collection for wet and dry waste.

A key takeaway is the importance of inclusivity in multi-stakeholder collaboration – ensuring that both formal and informal waste workers are engaged in the system. The Tan An pilot project in Viet Nam ([Case Study 2.1](#)) demonstrated that separating waste at the source into wet and dry streams significantly improved waste feedstock quality for recovery and recycling. However, challenges in effectively integrating informal waste workers resulted in many recyclables continuing to flow through informal channels, hindering the effectiveness of the formal municipal recycling facilities.

Initiatives such as Plastic Bank's in Manila City ([Case Study 2.3](#)) showed that the use of financial incentives combined with digital tracking systems and digital literacy education along

with formalising the informal sector can effectively boost and support waste collection and recycling rates - however, training refreshers should be offered to users. In Viet Nam's Phu Quoc ([Case Study 2.2](#)), collection coverage expanded to previously underserved communities successfully reduced plastic leakage to the environment and improved local waste habits, though maintaining consistent resident participation and sustainable funding remain ongoing challenges.



Waste Banks and Community-based Waste Management

PSC supported waste banks have generated economic opportunities for local communities and boosted recovery and recycling rates, particularly for plastics with market value. They engage local groups in waste sorting, material recovery, and strengthen the value chain both by contributing to collection efforts and interfacing with off-takers. Initiatives may overlap across different approaches and/or SWM stages. This is most evident for waste banks, which contribute to both collection and recovery/recycling efforts, as they facilitate collection while also ensuring materials are processed for repurposing and recycling.

Waste banks illustrate the critical role of community engagement and local leadership. Passionate and charismatic community leaders who have a clear mission to support their peers, and a vision of a cohesive and inclusive society are more likely to deliver impactful change. Some have effectively mobilised participation through tangible incentives such as educational support, utility payments, and cash rewards. Initiatives such as Thailand's Lung Dum waste bank ([Case Study 2.5](#)) and Indonesia's BS Kenanga waste bank ([Case Study 2.6](#)) illustrate the benefits of financial incentives and educational outreach in driving meaningful behavioural change. The adoption of digital applications has

enhanced transaction efficiency; however, varying levels of digital literacy among some user groups may influence uptake and overall effectiveness.

While waste banks offer educational, social, and local environmental benefits, their contribution to overall waste recycling remains relatively modest - generally recovering less than five tonnes per day per waste bank. This is partly attributed to space constraints and limited financial resources to support full-time staffing and infrastructure expansion. Achieving financial sustainability remains a work in progress across many case studies, with several initiatives continuing to explore pathways to fully cover their operational costs.

Limited land availability can present challenges for scaling operations. To ensure long-term viability beyond the initial financing period, developing a sustainable business model remains important. In parallel, strengthening market linkages alongside source separation efforts can help avoid bottlenecks in the flow of materials to off-takers. Lung Dum waste bank in Thailand ([Case Study 2.5](#)) demonstrated good integration by establishing a clear sourcing and destination pathway for recovered materials with [Wongpanit's](#) MRF.





Formal Collection

Recommendations



 National Government Policy Implementation: • Establish policies and regulations for universal waste collection coverage. • Mandate separation at source and enforce compliance with penalties/incentives. Inclusivity: • Support formalisation of informal waste workers into the formal collection systems.	 Private Sector (Operators) Performance Standards: • Where contracts are in place, ensure they include clear and outcome-focused performance standards (e.g. low leakage rates, route coverage, separation compliance) to avoid gaps in quality.
 Local Government Baseline Assessments: • Conduct baseline assessments to identify collection gaps and promote separation at source pilots and roll out. • Ensure high quality service delivery through strong technical design and contract management skills. Operator Models: • Ensure operator models are clear and all waste streams are covered by the collection systems. Integrate informal waste workers into local collection models. Collection Service: • Support service expansion to underserved areas and communities. • Upgrade collection services to reduce leakage to the environment.	 Civil Society/Communities Education: • Raise awareness on the importance of separation at source and how to segregate. Multi-stakeholder Collaboration: • Support community-led waste collection initiatives. • Advocate for inclusive policies for informal waste workers, including fair wages, access to social protection, and occupational health and safety standards.

Table 2. Recommendations for collection interventions



2.B

Waste Banks & Community-based Waste Management

Recommendations

 National Government Enabling Framework: • Provide legal and financial support for community-based waste management initiatives. • Ensure waste banks are integrated into waste management systems. • Develop incentives for waste bank participation (e.g., tax benefits, subsidies).	 Private Sector (Operators) Market Stabilisation: • Establish stable pricing leveraging on EPR or offer buy-back agreements through Deposit Return Schemes (DRS). Setting floor prices for plastics can also help to maintain price predictability.
 Local Government Infrastructure: • Facilitate land allocation for waste banks and community-driven initiatives. Where land is limited, prioritisation should be based on financial viability, material flow data, and potential impact – this may mean favouring multi-functional or higher-capacity facilities. Multi-stakeholder Collaboration: • Promote partnerships between waste banks, communities, and recyclers. Digital Tools: • Support mobile or digital waste bank models with app development or logistics tracking tools to enhance monitoring and adaptation of operations.	 Civil Society/ Communities Infrastructure: • Ensure waste bank facility spaces are large enough to receive, process and store forecasted incoming materials. Knowledge Strengthening: • Support exchange, training and capacity-building between waste bank operators. • Strengthen leadership and management within waste bank initiatives. • Encourage community participation through incentive programmes and awareness raising campaigns. • Develop partnerships and use digital tools to connect waste banks with recyclers and buyers. Ensure to leverage existing digital tools where available.

Case Study 2.1



Viet Nam: Tan An City, Long An Province

WWF Involvement: August 2020 to July 2021

Focus Area: Collection

PSC Approach: Formal Collection

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

Household Waste Separation at Source in Tan An

- **Separating wet and dry waste significantly improves overall material recycling:** This is the first step to enhancing the quality of both organic and recyclable fractions, notably increasing overall material recycling.
- **Integrating informal workers into the formal waste management system supports a just transition:** While the recycling of dry recyclable materials was limited in this instance, the informal waste sector plays a critical role within the solid waste management (SWM) system. Integrating informal workers into formal waste management structures can help capture more recyclables and ensure a just transition for these workers. This provides them with a stable income and social protection, strengthening both social equity and recycling outcomes.
- **Regular monitoring and visible feedback mechanisms encourage sustained waste separation behaviours:** Continuous waste segregation monitoring by waste collectors, combined with real-time feedback significantly improved household participation in waste separation. Providing households with visible evidence – such as seeing their organic waste converted into compost – reinforced trust, strengthened engagement, and supported lasting behavioural change.

Background

Viet Nam is a major contributor to marine plastic pollution, with the Mekong River serving as a significant pathway for waste entering the oceans (Pfaff-Simoneit, 2023). Tan An city, located in the Mekong Delta, was selected as a pilot area to address these challenges.

Waste collection systems in Long An Province are still in the process of being strengthened, particularly in rural areas. According to Pfaff-Simoneit (2023), around two-thirds of

the population have access to regular waste collection services. In areas where formal infrastructure is not yet fully established, unmanaged disposal practices, including open dumping on land and into water bodies, continue to occur. Separation at source and low-tech waste collection were introduced to capture organic, recyclable, and residual wastes, turning them into marketable products to reduce waste sent to landfill. Ward 3, in Tan An, covering a population of 16,618, was selected for the pilot.



Objectives

- Introduce a reliable and user-friendly separate waste collection system for organic, recyclable, and residual wastes at the household level.
- Implement a labour-intensive, low-tech waste collection system designed to enhance the quality and recycling of recyclable materials and create employment opportunities.
- Assess cost and revenue to determine whether high collection costs can be offset by revenues and cost savings, particularly reduced landfill expenses.
- Promote behavioural change among households to ensure waste source separation.



Key Successes

- **High organics recovery rates:** The separate collection system recovers 80% of organic waste from households, with less than 1% contamination, producing high-quality compost and increasing landfill diversion.
- **Environmental, social, and economic benefits:** Compost made from organic waste, invasive water hyacinths, and agricultural straw – which is usually openly burned – is quality tested and utilised by farmers. This compost replaces chemical fertilisers, which are more affordable and improves crop yields.
- **Cost recovery:** The sale of compost at the local market covers the costs of collection worker’s salaries and the purchase of new waste processing equipment. It is also projected that scaling the project to the city level in Tan An would yield cost reductions of 30 to 35% through economies of scale for the municipality (Pfaff-Simoneit, 2023).
- **Local Government Scaling Efforts:** The People’s Committee of Tan An City is assigned to continue waste separation in Ward 3 and develop a plan for citywide expansion. While the Department of Natural Resources and Environment is tasked with overseeing implementation in other districts.
- **Behavioural change:** Within two weeks, over 90% of households in the pilot area complied with separation at source practices, up from 33% at the start, due to monitoring conducted through household inspections by waste collectors, waste composition tracking, and interviews with residents and waste collectors.

Key Challenges

- **Retained dry recyclable waste:** Only 18% of dry recyclable waste was collected by municipal services as the rest was retained by households and given to informal waste workers. While informal sector activity is welcome, this prevented more materials to be collected through formal systems lowering the effectiveness of municipal recycling facilities.
- **Limited integration of the informal waste sector:** Regulatory restrictions prevented the timely inclusion of informal waste workers in the project, impacting the overall recycling of recyclable materials.
- **Coconut shells account for 10% of organic waste** but are not processed due to the absence of a shredder at the composting facility, coconut shells are currently redirected to the residual waste stream.
- **Lower participation from non-household generators:** Waste separation practices were found to be less consistent among businesses.



 Resources

Support: The pilot was funded by WWF, including salaries for the collection team of 19 members, the purchase of community composting bins, collection carts, and motorised collection equipment. Additionally, WWF covered the costs of training household participants and workers in proper waste separation. There are plans for handover to local authorities for continued operation.

Human resources: All household participants of the study were trained and educated on how and why to separate waste, becoming trainers within their communities to increase capacity building and local ownership. Five waste collectors were also trained for post-sorting of household and non-household waste to improve the quality of the separated waste fractions, while also monitoring participants to ensure proper separation of organic and residual waste streams. Workers reported that their workload was manageable and not too strenuous.

Equipment: Community composting bins were provided for residents to deposit their organic waste. While collection carts equipped for on-the-spot sorting allowed waste collectors to evaluate and ensure proper waste separation at the point of collection.

Stakeholder engagement: The significant 80% increase in separation at source amongst residents was driven by the involvement of the Women’s Union and Neighbourhood Association (community-based organisation) and informative conversations between waste collectors and residents. These interactions were especially effective as residents often felt more comfortable engaging with community representatives than local government officials.

Partners: Key partners included WWF-Viet Nam (lead implementing organisation and funder), the City of Tan An (local authority), and community-based organisations including the Women’s Union and Neighbourhood Association (mobilised residents). These partnerships ensured strong institutional support, smooth implementation, and high community engagement.

 Enabling Factors

- **Behavioural change and feedback mechanisms:** Educating and training households and non-households about waste separation is fundamental. A key driver for this was continuous monitoring – waste collectors assessed sorting quality at every collection and provided real-time feedback. Engagement further increased when participants saw firsthand how their organic waste was transformed into compost. This tangible feedback loop not only builds trust but also reinforces sustained engagement and commitment to the waste separation process.
- **Compost quality control** was required to ensure a high-quality output and instil confidence with its safety and effectiveness. The project followed a high-purity source separation model, where organic waste had less than 1% impurity (Pfaff-Simoneit, 2023). Quality control should also be maintained through regular testing.
- **Post-sorting quality assurance:** Having workers to post-sort the pre-sorted household waste ensures high quality. Better sorted waste is also less work for the waste collectors.

 Risks & Opportunities

- **Possible reduction in compliance:** If the quality of separation at source reduces among household and non-household generators and the waste cannot be taken directly to a composting facility, transport to transfer stations or material recovery facilities may be necessary to improve the sorting quality of collected waste. Continued engagement with the community and monitoring by local authorities could mitigate this risk.
- **Local Government Support:** The People’s Committee of Tan An City and the Department of Natural Resources and Environment will be responsible for the continuation and scaling of the pilot to other parts of the city and beyond. The government bodies now have the knowledge and experience to carry out this model’s expansion with potential policy enforcement for source separation.

Read more about this model here: [Enhancing Labor-intensive Separate Waste Collection and Utilization in APEC Economies](#)



Case Study 2.2



Viet Nam: Phu Quoc

WWF Involvement: July 2024 to December 2024

Focus Area: Collection

PSC Approach: Formal Collection

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

- **Securing formal integration and buy-in from stakeholders is essential:** Long-term success of the collection system relies significantly on securing formal support and coordination among local authorities, public service management boards, and residential areas. Extensive stakeholder engagement during the pilot phase proved crucial in aligning these different groups.
- **Waste audits and incentive-based initiatives effectively reinforce waste management practices:** Initiatives such as waste audits, sorting activities, and incentive schemes such as “Waste Exchange for Gifts” successfully strengthened participant commitment to proper waste management practices.



waste monitoring

waste separation training



Background

Phu Quoc, known as the “Pearl Island,” has experienced rapid tourism growth, leading to increasing environmental pressure, particularly in waste management.

Through a baseline plastic leakage study conducted through this project, 45 households in Neighbourhood 8 in Duong Dong Ward were experiencing ongoing waste disposal challenges contributing to environmental pollution with waste entering Duong Dong river and nearby marine

ecosystems in the absence of regular collection services (WWF KII 05, 2024).

In response, a pilot waste collection model was introduced by the local government to provide structured and expanded waste collection services, reduce pollution, and increase community participation in proper waste disposal and sorting.

Objectives

- Expand waste collection coverage to Groups 6 and 7 of Neighbourhood 8 which was not previously served.
- Reduce the leakage of plastic waste and other recyclables into the environment, particularly in hotspot areas along rivers and beaches.
- Encourage household participation in proper waste disposal and sorting.

 Key Successes

- **Collection coverage:** Within three months, the pilot programme collected nearly seven tonnes of household waste, including recyclables from the previously underserved communities. Based on the average rate of daily waste generation and composition, it was estimated that 687 kg (10% of total waste) of plastic waste was prevented from entering the environment.
- **Behavioural change:** Achieved over 90% participation rate in active waste segregation from households in the target collection area within the first few months of operation. This was achieved through incentive programmes including ‘Waste Exchange for Gifts’ and awareness raising campaigns to encourage participation, ultimately reducing the amount of waste leakage and littering observed in the target hotspot areas along rivers and beaches.
- **Community financial commitment:** 41 out of 45 households voluntarily contribute 30,000 VND/month (USD 1.20) to sustain the collection system, which is based on the current collection fee regulated by the city authority and collected by the public service.
- **Established a collaborative model** involving the local government, public service provider, and residents that showed promise for long-term sustainability. This will be handed over to the local government after the testing period.

 Key Challenges

- Formalising the **integration of the new collection route** into the MSWM system required extensive coordination: Aligning with existing systems involved significant effort and collaboration across multiple government agencies.

- **Ensuring consistent payment of the collection fee presented challenges:** While most households contributed regularly, a small number of households (4 out of 45) paid the collection fee inconsistently, suggesting room for improved engagement on payment mechanisms.
- **Establishing trust and buy-in from the community took time:** In areas with no prior formal waste collection, building trust in the system and securing community participation required ongoing engagement and awareness efforts.

 Resources

Support: WWF covered the initial operational costs, purchase of additional collection bins and waste collection trucks. They also brought together the local authorities, public service management board, and residential communities to collaborate and their technical expertise was given to local partners to design the collection system, establish routing, and train collection workers.

Human Resources: Waste collectors, community leaders, and volunteers.

Equipment: Waste bins, collection vehicles, and materials for public awareness campaigns.

Stakeholders: People’s Committee of Duong Dong Ward, Urban Works Management Board, local residents, and businesses, which helped to secure the project’s success.

 Enabling Factors

- **Strong political will and commitment** from local authorities to improve waste management services.
- **Availability of funding and technical support** from development partners to kickstart new initiatives.
- **Presence of active community groups** and resident associations that can facilitate engagement and participation.
- **Opportunities to integrate** new collection models into existing MSWM systems.

 Risks & Opportunities

- **Availability of government budget allocations and operational support:** to sustain new collection systems, the People’s Committee of Duong Dong Ward will need to maintain budgetary and operational commitment to ensure continuity.
- **Coordinating across different government agencies** and departments responsible for waste management remains a challenge, with multiple departments involved in local waste management responsibilities that needs to be upheld.
- **Introduction of new collection systems** may unintentionally disrupt existing informal waste livelihoods. Formalising informal waste workers can help mitigate these impacts through their inclusion within the focal collection systems.

Case Study 2.3



© Plastic Bank

Digital Literacy Training

Philippines: City of Manila, Metro Manila

WWF Involvement: January 2021 to December 2024

Focus Area: Collection

PSC Approach: Formal Collection

Systemic Intervention: Systems and Infrastructure

Key Lessons Learned

Boosting Collection in Manila with Blockchain Technology

- **Digital literacy training improves uptake of blockchain-based reward systems:** The use of blockchain technology in solid waste management (SWM) to improve traceability and transparency of material and financial flows is relatively new and promising. Providing digital skills training is important to ensure participation, particularly to support users who may have limited familiarity with digital tools. When successfully implemented, this digital model can lead to increased collection volumes by allowing informal waste collectors to easily track their contributions and instantly redeem rewards through the Plastic Bank app.
- **Financial incentives are key to boosting informal sector engagement and improving livelihoods:** Incentive-based models have shown to significantly increase participation in waste collection, underscoring the value of financial incentives in enhancing waste recycling efforts and supporting economic benefits within the informal sector.

Digital Literacy Training



© Plastic Bank

Background

Plastic pollution remains a critical issue in Manila City, where large volumes of plastic waste enter land and marine environments. [Plastic Bank](#) incentivises waste collection and recycling by integrating informal waste collectors through capacity building activities and use of the blockchain-based reward system via the [Plastic Bank application](#).

Blockchain technology is a decentralised digital system that securely records transactions. In this initiative, it enables

real-time tracking of plastic collection and ensures all payments and material flows are transparent, traceable, and tamper-proof – building trust and accountability across the recycling process.

Recovered plastics are transformed into Social Plastic® (Katz, D., 2019), which is reintegrated into the supply chain by corporate partners. With WWF's support, Plastic Bank has grown its network of schools, therefore recovering higher quantities of plastics.

Plastic Bank also engaged schools in partnership with the Department of Education, working directly with school heads and Parent-Teacher Associations (PTAs) to implement Information, Education, and Communication training on plastic pollution and waste management.

Aligned with RA 9003 (Ecological Solid Waste Management Act, 2000), the project worked closely with barangay leaders to secure local buy-in and train waste workers in Baseco,

a community in Barangay 649, Port Area. Baseco is known for its dense population and active informal waste collection sector, making it a key area for intervention.

Objectives

- Recover plastic waste to prevent environmental leakage.
- Strengthen the local waste collection system by integrating informal waste collectors, providing them with social and economic benefits through training and incentives.

Key Successes

- Plastic Bank collected a total of 328 tonnes of general waste from January 2021 until August 2024, surpassing their target of 100 tonnes for the full project period.
- The initiative also led to greater volumes of plastic collected in junkshops in Baseco, improving overall waste management.
- 161 waste workers completed Plastic Bank’s training programmes, which equipped them with skills to enhance collection efficiency and financial security. This included Social Protection Mechanism Training for access to government benefits and a Digital Literacy Programme to help participants track plastic collection, redeem incentives, and use financial services, ensuring efficiency, transparency, and inclusion.
- Financial incentives: Registered Plastic Bank members received bonus payments per kilogram of collected plastic, leading to higher participation rates, improved livelihoods, and a more structured plastic recycling system.

- School and community engagement: School heads appointed project coordinators to oversee the initiative with Plastic Bank, which trained them alongside 20 PTA officers. A one-day specialised training equipped them to educate parents and manage school waste collection efforts, ensuring long-term environmental awareness within school communities.

Key Challenges

- Limited access to technology: Although the Digital Literacy Programme enhanced engagement, some waste collectors who were less familiar with using digital tools faced challenges in adopting the Plastic Bank application, which affected their ability to participate consistently.

Resources

Support: WWF provided funding for training, logistics, and tools to support waste collectors, enabling them to increase plastic recycling and access social benefits as well as supporting the expansion of its engagement with schools.

Stakeholders: Collaboration between WWF, Plastic Bank, Department of Education, waste cooperatives, and corporate buyers.

Technology: The existing Plastic Bank app is central to this initiative. It allows waste collectors to transparently track collected materials, redeem financial incentives, and access financial services. It uses blockchain-based transaction tracking for transparency.

Human Resources: Field coordinators, trainers, and local informal waste collectors.

Enabling Factors

- The Plastic Bank model is sustained through corporate partnerships, where companies purchase Social Plastic® at a premium, funding the financial incentives provided to waste collectors.
- Integrating informal waste workers into formal systems and extending access to social benefits supports more inclusive and sustainable development outcomes.
- Digital payment infrastructure enables efficient and transparent incentive distribution, making it easier for participants to receive and track rewards.

Risks & Opportunities

- High costs for waste infrastructure: The capital and operational investment needed to establish waste segregation hubs and community composting facilities remains a key financial barrier that may affect the pace and scale of the project’s expansion.
- Role of Public-Private Partnerships: Potential to unlock private capital to enhance public services and improve informal waste picker livelihood to invest in better digital infrastructure and supporting policy to scale services.



Case Study 2.4



© Benjamin Estanislao / WWF-Philippines

central
Hat Yai Mall

Thailand: Hat Yai

WWF Involvement: October 2023 to October 2025

Focus Area: Collection

PSC Approach: Formal Collection

Systemic Intervention:
Policy Advocacy

Key Lessons Learned

- **Financial incentives can effectively support sustainable practices:** Generating revenue from waste sales highlights the financial viability of structured recycling programmes. Monetising waste streams through certified processing and established market linkages can help secure long-term sustainability.
- **Convenience and ease of use significantly influence participation levels:** When waste collection systems are simple and clearly structured, staff participation increases. Conversely, systems that are complicated or inconvenient – such as the drop-off system introduced at the mall, which housekeeping found difficult compared to the previous mixed-waste approach – risks lower participation.
- **Alignment between policies and implementation helps ensure sustainability:** Although the project is aligned with municipal action plans, consistent enforcement and stronger governmental engagement are important factors to improve and maintain long-term results.
- **Clear and intuitive communication encourages proper waste separation practices:** Public awareness of correct waste separation can be improved by using clear, colour-coded bins with visual instructions and strategic placement. Additionally, ongoing training and regular monitoring of staff can further reinforce effective separation practices.

water bottle
shaped Bin



© WWF-Thailand



© WWF-Thailand

Background

In order to move away from mixed collection and enhance plastic recovery from the waste generated at Hat Yai’s Central Mall, the shopping mall adopted a “take-back” programme in October 2023, set to run until October 2025. In preparation for the adoption and enforcement of an Extended Producer Responsibility (EPR) Law, recyclable plastic and low value plastics packaging (such as coffee cups, straws and lids), the Central Mall acts as a collection point for these waste

streams. Waste from the mall is then collected and processed at five Material Recovery Facilities (MRFs).

Objectives

- Integrate Extended Producer Responsibility (EPR) principles by capturing recyclable waste within the system and ensuring proper separation and processing.

Key Successes

- **Over 28.5 tonnes of plastic packaging was recovered** between October 2023 and December 2024 (WWF KII 07, 2024).
- **Strategic partnerships and institutional support:** The initiative successfully signed an Action Plan with the municipality of Hat Yai, and Memorandum of Understanding (MoU) between O-Cyco (recycler) and Central Hat Yai Mall, with the municipality acting as a liaison, strengthening public-private collaboration.
- **Increased recycling and waste capture:** The project has facilitated the structured collection of recyclable waste, ensuring it is sold to MRFs for processing, including EPR waste.
- **Integration with municipal waste management and certification:** Waste management practices in the mall have been improved, contributing to better environmental performance indicators. Central Group's mall performance framework dedicates 80% of its evaluation to environmental management, including waste and energy management (WWF KII 07, 2024).

Key Challenges

- **Awareness and knowledge gaps:** Housekeeping staff found the drop-off system challenging, particularly when identifying which waste could be sold or repurposed. Despite awareness-raising activities, customer understanding of proper waste separation remains relatively low.
- **Storage and transport constraints:** The mall currently has limited space for storing waste, and transporting waste to the five MRFs presents logistical challenges due to the distance. Waste is collected on a biweekly schedule.

- **Seasonal waste generation fluctuations:** Waste volumes increase substantially during festival periods, creating challenges for timely collection and processing. Outside of these periods, recyclable waste collected monthly typically ranges from 1 to 2 tonnes.
- **Uncertain market for recycled glass:** Although the project aims to recover all recyclable materials, glass recycling remains challenging due to inefficiencies in the contracted glass recycling facility.
- **Administrative delays:** A change in the mall's general manager in October 2024 resulted in delays to the review process, affecting timely decision-making and procedural improvements.

Resources

The initiative is a collaboration between the municipality of Hat Yai, Central Hat Yai and [O-Cyco](#) (an ocean bound plastics recycling company), with support from Wongpanit and multiple MRFs.

WWF's role: Facilitate coordination and collaboration between the municipality and private sector stakeholders; drive the management of plastic waste within the shopping centre to enhance the recycling rate of plastic items throughout the value chain, from materials offtake to consumption within the shopping centre.

Infrastructure and logistics: 30 bins have been placed inside and outside the mall for waste separation. Wongpanit provides transportation to the MRFs.

Human resources and training: Training was provided to mall staff and housekeepers on EPR principles and waste separation. Community awareness-raising efforts were conducted for mall customers.

Enabling Factors

- **Linking the Central Mall with private MRFs** connects the different stages of the value chain, from generation, collection to recycling, consequently increasing the recycling rate.

Risks & Opportunities

- **Price stability for recycled plastic:** Due to the low price for plastic materials, many MRFs in Thailand are only able to remain viable when they access premium international markets. The offtaking of materials from the Central Mall to the MRFs therefore depends on the MRF's ability to financially sustain their operations, which can be difficult if the input materials are not of high quality. Role of local and national government is needed for price stabilisation or incentive mechanisms. Additional efforts could be made to improve the quality of materials.
- **Scale requires government uptake:** While this initiative is aligned with the municipality's action plan, the absence of a designated municipal civil servant to oversee and actively support the implementation process has made it more challenging to maintain momentum and fully realise the initiative's intended impact. There is potential to scale these initiatives with added personnel for oversight.



Case Study 2.5



Thailand: Surat Thani

WWF Involvement: January 2023 to December 2024

Focus Area: Collection

PSC Approach: Community-based Waste Management

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

Surat Thani’s Pathway to Waste Bank Success

- **Leadership qualities significantly influence replicability of community initiatives:** The success of Lung Dum waste bank is closely tied to the unique leadership qualities of Mr. Lapon Phuekdej. Replicating similar initiatives elsewhere would likely depend on identifying or developing leaders who possess comparable dedication and community trust.
- **Investments in suitable equipment and infrastructure can enhance operational efficiency:** Having access to appropriate equipment, such as larger collection trucks, can considerably boost efficiency by increasing waste collection capacity and reducing transport frequency. At the same time, initiatives aiming to replicate this model would need to carefully consider the significant financial investment required for equipment and maintenance.
- **Strong collection systems rely on both infrastructure and community buy-in:** Lung Dum shows that pairing volunteer-driven collection with municipal support and reliable offtakers creates an effective collection model that maximises recycling and minimises landfill waste.

Background

Lung Dum waste bank started in the Wat Potawas Temple Community of Surat Thani, Thailand. Founded by the community leader Mr. Lapon Phuekdej, also known as “Lung Dum” or “Uncle Dum”. The initiative utilised a Buddhist temple as the central hub for waste sorting and community activities. Since then, Lung Dum has evolved into a [community recycling social enterprise](#) (as well as a waste bank) operating under the Surat Thani Provincial Administrative Organisation. This transition was officially marked in February 2024 (WWF, 2024).

Objectives

- Reduce the volume of waste going to the landfill by increasing recycling and recycling rates.
- Educate and engage the community about the importance of proper waste management.
- Provide financial incentives to encourage community participation, including scholarships, elderly care, and funeral expenses.



 Key Successes

- **Improved recycling rates** through household separation of waste, thereby reducing recyclable waste volumes being sent to the disposal site by 10 tonnes/month and thus reducing landfill costs for local governments.
- **Established a network of 180 volunteers** actively sorting and selling recyclable waste for Lung Dum, with an additional 161 household participants who separate their waste for collection.
- **The revenue generated supports various community programmes**, including educational scholarships, elderly care, and coverage of funeral expenses, sustaining the welfare of participants. Additionally, the project allocates 30% of profits to community benefits including scholarships and salaries, while the remaining 70% supports operational costs, including land rental, staff wages, and truck maintenance.

 Key Challenges

- **Price volatility of recyclable plastics** presents challenges for financial planning and long-term sustainability.
- **The existing collection fleet has a relatively small capacity**, which increases the frequency of trips and associated costs. At the same time, ongoing constraints in accessing larger-scale investment capital have made it more difficult to acquire larger vehicles that would support logistical efficiency.

 Resources

Support: Operations are supported through revenue from waste sales and additional financial incentives from WWF, amounting to 3 THB/kg (0.10 USD/kg) of plastics, as well as the construction for a new warehouse to run operations.

Infrastructure: Lung Dum used local radio broadcasts to educate and also conducted training sessions to raise awareness about proper waste management.

Stakeholders: Surat Thani Municipality partnered with Lung Dum, connecting him to relevant organisations that enabled him to act as a speaker and share knowledge on waste separation. While the collaboration with [Wongpanit](#) (a local MRF) ensures a reliable offtaker and market for sorted waste.

Human resources: A team of 180 community volunteers help collect and sort waste.

 Enabling Factors

- **Dedicated community leadership** and engagement by Uncle Dum, combined with financial incentives and community benefits, successfully motivated residents to participate and contribute.
- **Government support:** Surat Thani government supplied essential equipment and established key connections, facilitating operations and enabling expansion.

 Risks & Opportunities

- **Reliance on charismatic community leadership:** The initiative's continued momentum and replication to other locations could be impacted if leadership does not carry the same level of influence and trust within the community.
- **Availability of infrastructure and funding:** may influence the pace of operations and shape the potential for future scaling. Establishing sufficient space and engagement by the community will support long-term operations.
- **Price volatility of recyclables:** Need for government intervention to stabilise secondary plastic market.

Uncle Dum weighing collected waste



Case Study 2.6



Indonesia: Bogor

WWF Involvement: March 2023 to December 2023

Focus Area: Collection

PSC Approach: Community-based Waste Management

Systemic Intervention:
Systems and Infrastructure

Key Lessons Learned

Kenanga Waste Bank: Building an Integrated System in Bogor

- **Capacity-strengthening in business skills enhances operational sustainability:** WWF’s provision of capacity building in sales, business management, and financing emerged as particularly impactful for Bank Sampah (BS) Kenanga Waste Bank, effectively equipping the team with essential skills that strengthened their operations and supported long-term viability.
- **Financial incentives increase participation and integration of waste management practices:** Providing financial benefits such as cash savings and utility bill payments through the waste bank successfully motivated community participation, facilitating the integration of waste management into residents’ daily routines.
- **Black Soldier Fly (BSF) cultivation offers effective organic waste reduction:** While BSF cultivation has proven effective in reducing organic waste, its sensitivity to climate variations highlights the importance of careful management practices and contingency planning to maintain a stable and productive BSF system.
- **Digital waste management systems improve efficiency with appropriate user education:** Adopting digital tools such as waste management applications significantly improved operational efficiency, though effective implementation required educating users on correctly confirming and managing data.

Background

Established in 2017, BS Kenanga waste bank serves as a model for community-driven waste management in Bogor City, integrating plastic waste collection, organic waste processing, and digital transactions while offering financial incentives to its customers. The waste bank operates under Government Regulation (PP) No. 18 of 2008 and Regional Regulation (PERDA) No. 9 of 2012, which mandate systematic waste management at the community level.

BS Kenanga has earned recognition for its impact, winning Best Waste Bank in Bogor City at the Bogor Ku Bersih event (2021) and securing 2nd place in the Self-Help Residential category in both 2021 and 2022. Beyond waste collection, it functions as an educational hub, attracting university students and receiving over 60 study visits in 2022 after being recognised as Bogor City’s first “Trash-Free RT” in February 2022. It currently has over 200 customers (63 digital and 150 conventional customers) from households and businesses (Nofita et al., 2024).

In March 2024, assistance was received from the Ministry of Cooperatives and small and medium enterprises (SMEs) (Kemenkop). This was an institutional capacity enhancement, upgrading from a Waste Bank to a Cooperative, and the support was a three-wheeled motorcycle from PT Permodalan Nasional Madani, a state-owned enterprise focused on empowering micro, small, and medium enterprises as well as cooperatives.

Objectives

- Establish an integrated waste management system for both organic and non-organic waste.
- Engage residents of Babakan Village in sustainable waste management practices through incentives.
- Introduce BSF organic waste processing to reduce landfill waste and generate additional community revenue.

Key Successes

- **Customer incentives:** Customers earn money for depositing separated waste at BS Kenanga, which can be withdrawn anytime or used for utility payments, including gas and electricity, or school fees via the PPOB (Online Bank Payment Point).
- **Customers have adopted digital waste banking** via an app launched by start-up Octopus, then the PSC [Aplikasi Data Sampah Indonesia](#) (AKSI) application, allowing customers to log waste details, schedule pickups, increasing accessibility. However, this requires user training to ensure correct data input.
- In 2021, **a BSF facility was established**, encouraging customers to donate organic waste for compost production. The compost is returned to the community, and the larvae are sold as animal feed with any sales proceeds used to provide groceries for local residents. This initiative modestly reduces landfill waste by 12 to 15 kg/day.
- **Capacity building and training** provided by WWF in sales, business management, financing, and technical skills significantly strengthened BS Kenanga’s efficiency, organisation, and financial planning. As a result, the waste bank has been able to expand waste collection, improve customer engagement, and hopes to move towards profitability in 2025.

- BS Kenanga has made **a significant contribution to the waste free RT initiative in the area**. As a pioneer, they have consistently excelled and emerged as champions. Moreover, BS Kenanga is regularly designated as a model site by the Environmental Agency (DLH) for Adipura assessments.
- In 2023, **BS Kenanga received the Raksa Prasada Award** from the Governor of West Java. This award is a recognition from the Governor of West Java in the field of environmental conservation that have demonstrated commitment and tangible actions in environmental preservation in West Java.

Key Challenges

- **Small processing space** at the waste bank, requires some materials to be transferred to other waste banks.
- **Shredding equipment is not yet in place**, so some organic waste streams are directed to external facilities for additional processing
- **Rainy season affects BSF production**, as BSF requires significant sunlight for optimal growth.
- **Cardboard waste revenue has declined**, due to a 70% drop in market price, making it currently less profitable than plastic waste.



Resources

Support and infrastructure: WWF provided capacity building for the waste bank, a vehicle to facilitate waste collection, a laptop, and a mobile phone to manage digital waste transactions and connect households directly to waste pickers, as well as 18 processing ponds within their BSF house (14 m²).

BS Kenanga have 20 drop boxes and supplied organic waste bins to their customers who bring their waste to the nearby waste collection points (TPS). The waste bank's processing capacity is 1.5 to 2 tonnes/month (Nofita et al., 2024).

Human Resources: 27 personnel are employed to manage and operate the waste bank, including an administrative and waste processing team.

Stakeholders: Partnerships are established with the community, schools, restaurants, hotels, and businesses.

Enabling Factors

- **WWF's capacity building and training** in sales, business management, financing, and technical skills have been recognised by BS Kenanga as particularly impactful, significantly contributing to improved operations and long-term sustainability. With this foundation in place, BS Kenanga is aiming to achieve profitability in the near term.
- **Supportive government regulations** have created an enabling framework for community-level solid waste management, offering a strong policy foundation that empowers and legitimises local initiatives.
- **Strategically placed waste collection dropboxes** in schools, restaurants, hotels, and businesses have supported source separation and improved logistics, helping to streamline collection and transport processes.

Risks & Opportunities

- **BSF quality:** Organic waste processing using BSF remains sensitive to climate, particularly during periods of excessive rain, which can affect output and consistency.
- **Market fluctuations:** The prices of recyclable plastic materials are subject to change, which may impact profitability and financial planning.
- **Further government support:** Providing incentives for community-based waste management through provision of financial incentives or infrastructure support to expand wider uptake and scale of waste bank role across Bogor.
- **Dependency on external digital applications:** this form of connectivity and data management heavily relies on an external platform where sustainability may be uncertain as exemplified by the exit of the Octopus app.



Case Study 2.7



Indonesia: Depok

WWF Involvement: November 2022 to April 2024

Focus Area: Collection

PSC Approach: Community-based Waste Management

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

Rumah Harum: The Last Centralised Waste Bank of Depok

• **Rumah Harum waste bank took the time to deeply engage with the community, building trust through consistent service, strong relationships, and visible results:** Its leader became a well-known and respected figure, key to the waste bank’s survival while others closed down. Over 15 years, they prioritised educating residents before asking for participation, learned from waste pickers, and created community-centred solutions such as decentralised unit waste banks. By working with schools, supermarkets, government, and households – and adapting operations to local needs – they made participation easy, inclusive, and meaningful. This trust-based, transparent, and responsive approach proved essential for long-term success and sustainability.

• **High operational costs may limit scalability and continuity:** Storage capacity, transportation, and labour demands can present significant barriers to growth and long-term implementation, particularly when cost efficiency is not addressed early in programme design.



Background

Established in 2013 as one of seven major waste banks in Depok, Indonesia, BSI (Bank Sampah Induk or ‘Waste Bank’) [Rumah Harum’s](#) aim was to promote community-driven waste management. Since then, the others have closed down. Rumah Harum introduced dropbox collection systems at supermarkets, schools, and government institutions, allowing residents to easily deposit their recyclables, handling waste from over 110 unit waste banks. It successfully processes and sorts a wide variety of materials, including

plastics, paper, metals, glass, household tools, and electronic waste (e-waste). It also serves as an educational hub for universities and government agencies, such as the Ministry of Public Works and Housing and the Ministry of Environment and Forestry, to learn about community-based waste management. They transitioned to a Cooperative and also received the Raksa Prasada Award in 2023 from the Governor of West Java, earning the title of the best community-based Central Waste Bank in the province.

Objectives

- Improve waste management practices in the local communities by promoting source separation and recycling.
- Engage and empower the community to take an active role in managing their waste.
- Develop a sustainable and scalable model for waste collection, sorting, and processing.

Key Successes

- BSI Rumah Harum is the **only fully operational Central Waste Bank in Depok** and collaborates with another PSC partner offtaker, Waste4Change. The waste bank manages around 60 to 80 tonnes of materials per month.
- **The waste bank grew** from receiving waste from 60 unit waste banks, in 2018, to 110, in 2023, involving 700 to 1,000 people actively separating their waste, including schools, supermarkets, government offices, and mosques effectively collecting and channelling this waste to the central facility (Norita et al., 2024).
- **Developing strong relationships and trust** with the local communities, leading to their active participation and support. Their strong ties to the local community are what kept this waste bank still operational after seven other waste banks closed down.
- **Expanding the range of materials collected**, including plastics, metals, glass, and e-waste.

Key Challenges

- **Storage costs and space availability:** The limited availability of land contributes to higher storage costs and presents practical considerations for the scalability of operations.
- **Fluctuating waste market prices:** For example, sorted PET bottles with printed screens sell for less than the same bottles without printed screens, consequently increasing labour requirements and associated costs through manual removal.
- **Sales and marketing for low-value plastic waste remain an ongoing area for development:** While high-value plastics are sold smoothly, identifying consistent and sustainable outlets for low-value plastics continues to present challenges.
- **Warehouse operations are under pressure due to the volume and diversity of incoming materials:** The facility accommodates a range of waste types from Unit Waste Banks, and current storage capacity places constraints on how waste can be organised, managed, and processed.
- **Transportation and labour costs:** Collection requires minivans and pickup trucks, which adds to operational expenses. Employees often work extended hours (until 22:00) to meet demand.
- **Reaching and serving a larger percentage of the population in Depok:** Currently, less than 10% of the population participates in waste separation and collection activities, with the remainder of waste typically sent to landfills.



Resources

Support and infrastructure: WWF provided four trucks to facilitate waste transport, a baler, an extruder, a shredder and warehouse space to improve operations. More than 27 dropboxes were also provided for PET plastics, glass, and cardboard collection. They also received a three-wheeled motorcycle from an investment firm.

Human Resources: 20 employees are involved in sorting, processing, and logistics. WWF also provided capacity building support for BSI Rumah Harum in various aspects, enhancing their skills and knowledge to improve waste bank operations.

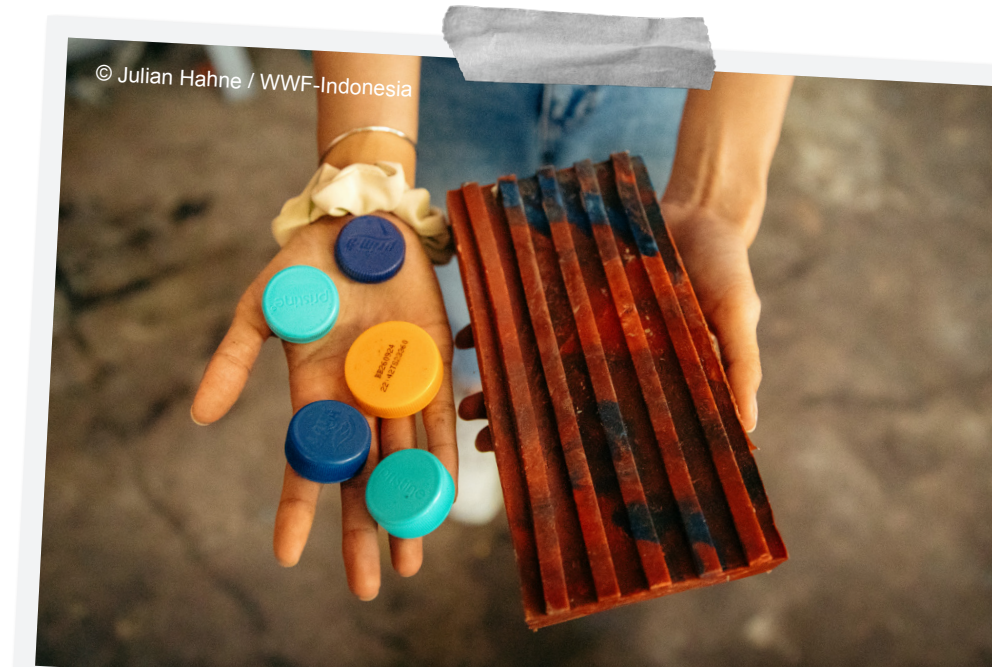
Stakeholders: Key partnerships were established with schools, supermarkets, and government agencies to expand the reach and impact of the programme.

Enabling Factors

- The **provision of land by the local government** played a key role in facilitating the initiative.
- **Strong community participation and ongoing local education** – particularly through schools and supermarkets – helped increase programme visibility and engagement.
- **Financial incentives for households**, generated through waste sales, contributed to motivating participation and encouraging sustained involvement.
- **Strategic partnerships with businesses** supported the steady flow and demand for recyclable materials.
- **Extending working hours and optimising transportation** arrangements have helped address operational demands in a responsive manner.
- There is a strong interest in **expanding into upcycling activities** this year, as a way to diversify revenue streams and enhance the value of collected materials.

Risks & Opportunities

- **Capacity strengthening of waste workers** remains essential to ensure proper handling of collected materials. Without sufficient training, there is a risk that waste may be mismanaged, including through burning or open dumping, as observed in some local junkshops.
- **Maintaining consistent and sufficient funding** to support ongoing operations, including transportation and labour costs, is a critical consideration for long-term sustainability.
- **Market price stabilisation for recycled material** is needed at the local and national level to allow waste banks such as Rumah Harum to anticipate financial sustainability.
- **Policy for better segregation at source** will significantly reduce manual labor cost for waste banks and improve quality of recyclables.
- **Addressing awareness and knowledge** around waste management in some communities will require targeted education and outreach campaigns to encourage behavioural change.



Case Study 2.8



Thailand: Songkhla City

WWF Involvement: March 2021 to December 2024

Focus Area: Collection

PSC Approach: Community-based Waste Management

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

- **Community ownership models can strengthen commitment and scale impact:** The shareholder model, combined with regular surplus allocations, contributed to greater financial commitment and local engagement, supporting the expansion of waste banks, advancing marine conservation efforts, and reinforcing environmental stewardship.
- **Reliable market linkages support long-term financial sustainability:** Partnerships with Siam Natural Group and [Wongpanit Krabi](#) – operators of the local junk shops and MRF – created consistent offtake pathways for recyclables, helping ensure the economic viability of the initiative over time.

Songkhla's Fishing community Takes Lead in Enhancing Waste Management Systems in coastal Areas



Background

[Baan Talae Nok](#) and [Baan Pang Sai](#) are coastal fishing villages in Songkhla Province, Thailand, where plastic waste mismanagement has contributed to marine pollution and environmental degradation. Until recently, formal waste management systems had not been introduced in these communities, resulting in the gradual accumulation of waste in coastal areas over time.

WWF in collaboration with [Thai Sea Watch Association \(TSWA\)](#) and Wongpanit, established community waste banks to incentivise waste collection and sorting. These banks provide financial returns to members, helping sustain the initiative while reducing plastic pollution.

Objectives

- Establish sustainable waste management systems in coastal fishing communities by implementing community run waste banks.
- Promote community ownership through a shareholder investment model to ensure financial sustainability.
- Strengthen marine conservation efforts by dedicating a portion of waste bank profits to environmental initiatives.

Key Successes

- A **community managed shareholder model**, inspired by [Baan Mod Ta Noi's community waste bank](#) in Trang City, assists with regular income distribution and financial transparency where members invest 20 THB/share and 10 THB/share, in Talae Nok and Baan Pang Sai respectively (capped at 10 shares/person). Surplus funds are distributed biannually, with 50% to members, 10% for project management, 10% as reserve funds, 15% for member welfare, and 15% supporting marine conservation (SD39 Group and PXP Sustainability, 2025).
- **Volunteer-based operations** have been supported by long-term engagement. TSWA's sustained presence in the region helped foster community participation. Leadership training and knowledge-sharing sessions were provided to empower local leaders to deliver waste management education throughout the community.
- **Ongoing capacity building and technical assistance** by TSWA have played an important role in raising awareness and strengthening community knowledge.
- **Newly introduced collection routes** have contributed to operational efficiency, helping increase recycling rates and reduce marine litter.



Summary

Introduction

Key Challenges

- **Initial awareness gap:** At the start of the initiative, the two fishing communities had not yet been widely introduced to formal SWM systems. This highlighted the need for dedicated education efforts and long-term behavioural change initiatives.
- **Maintaining consistent participation:** Sustaining active involvement from all members beyond the initial enthusiasm remains an ongoing challenge and requires continuous community engagement.

Resources

Support and infrastructure: WWF provided support for the new warehouse that was built for permanent waste bank operations in Baan Talae Nok. Equipment such as waste bags, a scale, calculator, logbooks, receipt books were supplied to both communities to assist with operations.

Human resources: Baan Talae Nok has 13 committee members, 20 volunteers, and seven advisors (SD39 Group and PXP Sustainability, 2025).

Partnerships: TSWA implemented the initiative, established the waste bank, and provided technical and managerial support, while Siam Natural Group (a local junkshop) and Wongpanit (MRF), trained the communities on how to sort waste, ensuring a market for collected waste.

Benjawan Pengnu at the community meeting, sharing knowledge on improving the community's economy through waste management.

Fishing nets being distributed to the community members for collecting marine debris

Enabling Factors

- **Initial financial support** from WWF enabled the establishment of a permanent waste bank warehouse.
- **Technical support and training** from TSWA facilitated the introduction of structured collection systems and laid the foundation for sustainable operations.

Risks & Opportunities

- **Dependence on dedicated community leadership:** The success of the initiative currently hinges on a small group of highly engaged leaders, which could affect continuity if leadership transitions are not planned. Continued engagement of other potential leaders in the community is key for sustained operations.
- **Shareholder investment model may not suit all communities:** The approach may need to be adapted in areas where a shareholder model is less culturally or socially accepted - community stakeholder consultations should be conducted prior to any replication of this model.
- **Behavioural change and communication** with the community should be encouraged with local government's efforts and/or incentives.



Reduction

Collection

Recovery & Recycling

Enabling Framework

Replication & Scaling

Investing in CE



3



Recovery & Recycling

3 Recovery & Recycling

Introduction

Recovery includes any process that extracts value from waste, including material recovery or energy recovery. Recycling refers to the process of reintroducing materials into the production cycle to create new products by sorting, cleaning, and processing materials into secondary raw materials that can replace virgin resources. Beyond recycling, recovery also encompasses the utilisation of recovered materials for composting (for compost-like output e.g. used for landscaping), material recovery (for solid recovered fuel/refuse derived fuel), anaerobic digestion (for biogas and digestate), and incineration (for electricity or heat) (UN-Habitat, 2021). See [WWF's position on chemical recycling](#) for more information on implementation principles.

Recovery and recycling initiatives are integral to PSC's approach, focusing on enhancing the capacity and efficiency of material recovery facilities (MRFs) and waste banks, by supporting existing infrastructure through the provision of equipment and infrastructure, while also facilitating the establishment of new facilities where necessary. More than just setting up the recovery and recycling process, addressing factors such as waste collection prior to recycling, and subsequent market linkages for recyclable waste are also key. The recovery and recycling stage rarely involves only investing in equipment and facilities, but also in service and value chains.

When materials have been processed in recovery and recycling facilities, offtakers are needed to purchase output materials. Having offtakers ensures that recyclables, especially plastic, do not end up as waste again. If there is no market for recycled plastics (or other materials), they may be discarded, either because they are too low-value or because the recovery or recycling process has not been optimised. It is essential to have multiple offtakers in the market to ensure that the recycled materials have different potential uses.

This section presents five case studies, shown in Table 4.



Recovery and Recycling

Case Study Country (City/Site)	
3.1 Jakarta's Waste Collection Collaboration Indonesia (Jakarta)	3.4 Bogor: Bantar Kemang And Mekarwangi's Recycling Indonesia (Bogor)
3.2 Waste4Change Empowers Junkshops Indonesia (Depok)	3.5 Recycling for Change: San Isidro's Social Shift Philippines (San Isidro)
3.3 Cu Lao Cham: Small Island Scales Up Community MRFs Viet Nam (Cu Lao Cham)	

Table 4. Summary of case studies in the 'recovery and recycling' stage

☆ **Summary**

The success of recovery and recycling facilities lies in strengthening local collection networks and market linkages and promoting public-private partnerships to achieve operational efficiency and scalability. A well-integrated network connecting communities, waste banks, MRFs, and local and national offtakers enables an end-to-end recycling of plastic waste, from collection to processing and final material offtake.

Additionally, if one offtaker goes out of business or changes its purchasing, having alternative offtakers for different waste streams reduces the risk of the recyclables being without a market. Scaling up recovery and recycling facilities is most successful when supported by enabling policies, such as landfill pricing mechanisms that incentivise diversion from disposal. Expansion efforts are more likely to succeed when grounded in a clear understanding of location-specific realities, including transport logistics and local market conditions. Furthermore, the more materials collected, the more cost-effective the recycling process becomes due to economies of scale.

 Recovery or Recycling Facilities

Designing recovery and recycling infrastructure and specifying equipment to ensure processing capacity aligns with waste volumes is a key success factor for any recovery and recycling facility. Careful planning and well-executed feasibility studies can help mitigate potential financial and operational challenges. Ideally, such assessments consider waste composition, market demand, financial viability, and how the facility fits within the broader solid waste management system. Mekarwangi MRF in Indonesia ([Case Study 3.4](#)) illustrates this point, where challenges related to production capacity and market demand created barriers to achieving high efficiency and impact. In addition, given the potential for market fluctuations and operational risks, incorporating contingency measures – such as financial buffers and emergency storage – can enhance facility resilience.

Infrastructure investments tend to deliver the most value when they are aligned with expected processing needs and projected waste volumes. Public-private collaboration can support this alignment, with the public sector often contributing land and the private sector investing in equipment and technology. Transparency in operations, especially when engaging the informal sector, is important for building trust and ensuring long-term sustainability. Waste4Change’s work in Indonesia ([Case Study 3.2](#)),

formalising informal waste workers and implementing digital traceability systems, demonstrates a constructive approach to achieving this. Consideration of site design and day-to-day operational management also plays a role in reducing the risk of plastic leakage. Observations from Bantar Kemang, Indonesia ([Case Study 3.4](#)), suggest that open structures and less robust containment strategies may contribute to leakage, highlighting the benefits of secure storage and well-defined site boundaries.

As collection services expand, recovery and recycling facilities’ capacities need to cope with the additional stream of materials to prevent plastic waste from ending up in uncontrolled disposal sites or leaked into the natural environment. The more materials processed, the more cost-effective recovery and recycling become due to economies of scale. Jakarta’s MRF ([Case Study 3.1](#)) is planning for this. Once MRFs achieve stable, resilient operations, recovery and recycling efforts can be further expanded.

San Isidro, Philippines ([Case Study 3.5](#)) shows how recovery systems coupled with enabling conditions can also drive social change. A centralised MRF, run by informal waste workers and a women’s association, transforms plastics into marketable goods, linking recycling with livelihoods. Strategic facility placement improved efficiency, while a draft Gender and Plastic Policy Ordinance helped formalise worker rights and promote inclusion.



3.A

Preparation and Planning

Recommendations

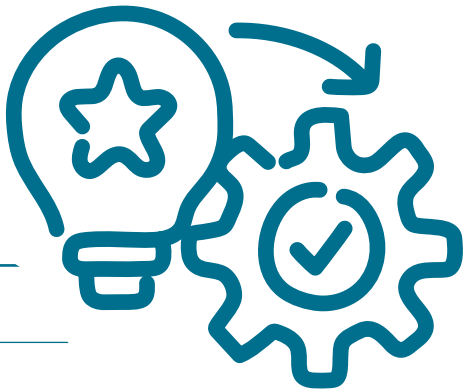


 National Government Systems Design: - Require feasibility studies before approving new recovery and recycling facilities. Provide clear frameworks and guidance for local governments to establish low leakage material recovery and recycling facilities. Policy Implementation: - Develop policies to stabilise market prices for recyclables, including EPR mechanisms. Establish national standards and assessment protocols for microplastics in recycling and recovery operations to monitor potential emissions and mitigate environmental and public health risks.	 Operator* *Whether public/ private Systems Design: Conduct feasibility studies and market assessments prior to any construction. Develop risk assessments and contingency plans addressing environmental (leakage, fire), operational (equipment failure, staffing), and market (price fluctuations) risks to ensure preparedness and facility resilience. Infrastructure: - Invest in recovery and recycling infrastructure and equipment and ensure processing capacity matches waste volumes. Partnerships: Partner with local governments for land access and regulatory approvals.
 Local Government Systems Design: - Identify suitable land and infrastructure needs for recovery and recycling facilities. Ensure operator models are clear to define accountability of waste flows with inclusion of the informal waste sector. Ensure prioritisation of reduction and reuse before recycling and recovery, and establish recycling facilities in line with WWF's Position Paper on chemical recycling.	 Civil Society/ Communities Policy, Advocacy, Communications: - Advocate for sustainable recovery and recycling practices and infrastructure development with inclusion of the informal waste sector. Support awareness campaigns on waste separation, recovery and recycling.

Table 3. Recommendations for recovery and recycling interventions

3.B Implementation

Recommendations



 National Government Policy Implementation: - Set national standards for recovery and recycling facility operations and performance. Extended Producer Responsibility: - Encourage private sector investment through EPR policies and implementation and public-private partnerships.	 Local Government Operational Standards: - Ensure local facilities meet environmental and operational standards such as low leakage measures. Partnerships: - Provide public-private partnership opportunities for facility development.
 Operator* *Whether public/ private Systems Design: Ensure operator models are clear to define accountability of waste flows and financial sustainability.	
 Civil Society/ Communities Partnerships: - Support waste bank initiatives. - Facilitate collaboration between informal and formal stakeholders/facilities.	Three travel agencies sign a commitment to reduce single-use plastic with Hue's Plastic Smart cities. 



Sustainability

Recommendations

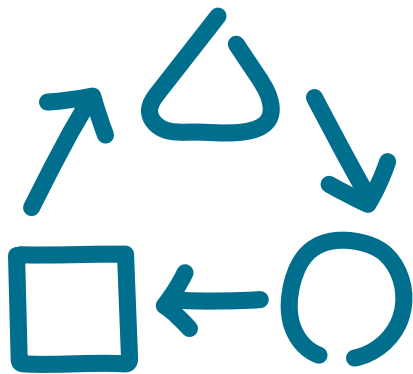


 National Government	Knowledge Strengthening: • Develop capacity-strengthening programmes for formal and informal sector recyclers as well as integrate informal workers into planning and implementation. Disposal Pricing: • Promote disposal pricing mechanisms to incentivise recovery and recycling.	 Local Government	Knowledge Strengthening: • Develop and implement awareness raising campaigns on recovery and recycling and separation at source. Disposal Pricing: • Encourage and advocate for disposal pricing to stimulate the recovery and recycling system.
 Operator* <i>*Whether public/ private</i>	Knowledge Strengthening: • Provide technical training for facility staff and informal waste workers.		
 Civil Society/Communities	Multi-stakeholder Collaboration: • Promote community engagement in recovery and recycling initiatives and education campaigns with inclusion of the informal waste sector.		

3.D

Monitoring and Adaptation

Recommendations



 National Government Monitoring: • Provide guidance for design and implementation of monitoring systems to prevent plastic leakage from facilities prior to establishment. • Provide funding for regular data collection, systems maintenance, and trainings. • Regularly use data for analysis and evidence-based decision making to inform program adaptation and policy reform where needed.	 Operator* *Whether public/ private Systems Design: • Ensure facilities are as plastic leakage-free as possible, through closed containment and storage of waste, closed transport vehicles and fenced boundaries. Monitoring: • Strengthen monitoring systems and containment strategies to minimise leakages. Scaling: • Scale and replicate recovery and recycling facilities depending on local contexts and enabling frameworks.
 Local Government Systems Design: • Ensure containment strategies are in place to minimise waste leakage, such as secure storage, physical barriers, and standard operating procedures. Scaling: • Support the scaling of recovery and recycling facilities based on demand and market conditions.	 Civil Society/Communities Advocacy: • Advocate for monitoring policies and regulations with standardized indicators that inform and strengthen the recovery and recycling market while improving environmental safeguards. Knowledge Strengthening: • Support knowledge and data sharing across organizations, institutions, and authorities.

Case Study 3.1



Indonesia: Bekasi, Bogor, Depok, Jakarta (Greater Jakarta)

WWF Involvement: December 2023 to January 2025

Focus Area: Recovery and Recycling

PSC Approach: Recycling

Systemic Intervention: Knowledge Strengthening

Key Lessons Learned

Jakarta's Waste Collection Collaboration

- **Integrating the solid waste management (SWM) chain supports operational continuity:** Collaborating with waste aggregators and sourcing supplementary materials contributes to building integrated solid waste management systems, while helping to maintain a steady feedstock for processing and ensuring continuous operational flow.
- **Diversifying revenue and scaling volumes supports financial sustainability:** Expanding processing volumes to reach economies of scale, alongside diversifying revenue streams, can contribute to long-term financial sustainability of waste management operations.

Dump truck weighing - RECO Hub



Background

The privately operated RECO Consortium integrates [REKOSISTEM](#) and [SweepSmart](#) to improve plastic waste management through collection and sorting.

REKOSISTEM manages waste collection, picking up waste from households, businesses, and aggregators through a digitised tracking system. It also operates drop-off stations where users receive rewards per kilogram of waste.

SweepSmart provides technical expertise for system integration, using its [Material Recovery Facility \(MRF\) model in Ambon](#) to optimise sorting through semi-automated conveyor belts, ergonomic systems, and improved logistics.

RECO's operations are designed to reduce plastic leakage into the environment, improve material circularity, and create economic opportunities for informal waste workers. The hub currently serves 3,467 clients (3,285 households

and 182 businesses) in Greater Jakarta, including Bogor, Depok, and Jakarta.

Objectives

- Establish a high-capacity waste processing facility handling 20 tonnes of mixed waste daily.
- Provide sustainable employment opportunities for the informal waste sector.

 Key Successes

- **Waste processing and revenue growth:** Since its launch, RECO has collected 4,000 tonnes of mixed waste plus 1,800 tonnes of plastics over 11 months, generating IDR 6.16 billion (USD 388,000) in revenue within its first operational year.
- **Diversified revenue generation:** Financial stability is maintained through a diversified revenue model, combining subscription fees from the REKOSISTEM service and material sales. This diversification mitigates financial risks, supporting long-term operational viability.
- **Increased efficiency:** The integration of sorting and processing equipment (baler and shredder) has driven an estimated 87% cost reduction per tonne, decreasing from USD 270.24 in 2023 to a projected USD 34.72 by 2025. As processing capacity scales to 6,085 tonnes annually, further cost efficiencies are expected.

 Key Challenges

- **Financial dependency:** While revenue is currently being generated through collection fees and material sales, the operation continues to be supported by partner funding during this stage. Advancing toward financial self-sufficiency will likely require continued investment in infrastructure, workforce development, and scaled operations.
- **Collection rates:** Current collection rates remain below the project’s overall targets. Enhancing process efficiency and increasing collection volumes will be important steps toward meeting the goal of 6,085 tonnes per year. As of 2025, the annual collection stands at 1,589 tonnes.

- **Scaling delays:** Progress toward full operational capacity was slower than anticipated due to earlier delays in infrastructure development and equipment procurement. These have since been addressed, allowing for continued advancement.
- **Operational complexity:** Coordinating the activities of multiple consortium members introduced logistical and management considerations that required ongoing collaboration and adjustment to ensure alignment across the initiative.

 Resources

Support and infrastructure: WWF provided a grant which was used to enhance infrastructure, purchase machinery, and support operational costs. The investment improved material recycling efficiency by funding the development of sorting, washing, and shredding lines at the REKOSISTEM’s central hub in Bekasi City, bordering Jakarta. The facility now operates with a sorting capacity of 10 tonnes/day and a monthly processing capacity of 600 tonnes.

Human Resources: 138 employees are employed including sorting and administrative personnel. Additionally, the facility employs five waste pickers, utilising their expertise to improve sorting efficiency, while reducing training costs, and providing stable employment opportunities.

Stakeholders: Collaboration with aggregators such as Waste4Change and multiple offtakers ensures a steady supply of materials for continuous operations.

Technology: The REKOSISTEM app is used to track waste flows, ensure quality assurance, and monitor environmental impact.

 Enabling Factors

- **Scalability potential:** RECO’s modular consortium model offers flexibility to expand collection coverage and processing capacity. Partnerships with government actors – particularly those able to provide land or co-financing – could play a key role in supporting future growth.
- **Financial sustainability:** Continued revenue growth depends on increasing processing volumes and securing additional offtake agreements to ensure long-term financial resilience.

 Risks & Opportunities

- **Logistical and scaling barriers:** As waste collection and processing activities grow, challenges related to transport, material storage, and supply chain coordination may become more complex. Strong logistics planning and optimised operational workflows will be critical to maintain efficiency across multiple waste sources.
- **Risk mitigation strategies:** Strengthening governance structures, implementing quality assurance processes, and further improving sorting efficiencies will be important for ensuring long-term impact and replicability.



Sorting station
- RECO Hub

Case Study 3.2





© Veronica Maureen / WWF Plastic Smart Cities

Indonesia: Bekasi, Bogor and Depok (Greater Jakarta)

WWF Involvement: December 2023 to June 2025

Focus Area: Recovery and Recycling

PSC Approach: Recycling

Systemic Intervention: Systems and Infrastructure

Key Lessons Learned



- Diversifying offtakers helps to stabilise cash flow and improve market resilience:** Working with a diversity of offtakers who accept different types of materials (in this case, accepting both shredded and non-shredded plastic) allows for greater flexibility, supports steady revenue, and opens access to higher-value sales. Tailoring product types to match market demands can also help secure longer-term offtake agreements.
- Digital traceability systems strengthen oversight and unlock financing opportunities:** Implementing traceability tools enhances transparency, enables impact-driven reporting, and supports access to blended financing mechanisms, including plastic credits - however, see [WWF's Position Paper on Plastic Crediting and Plastic Neutrality](#) (April 2025).
- Connecting waste banks directly to aggregators improves supply chain efficiency:** Streamlining material flows by linking waste banks with aggregators and recyclers reduces logistical inefficiencies and increases the overall effectiveness of the recycling system as exemplified by the strategic partnership with RECO.
- Integrating informal waste workers can enhance system performance and speed up onboarding:** Formalising the role of informal waste workers helps harness their existing expertise, minimising the need for extensive retraining while improving operational efficiency within structured waste systems.

 Background

Since 2014, [Waste4Change \(W4C\)](#) has operated as a social enterprise, in the private sector, focusing on processing flexible plastics (PP) and strengthening partnerships with junkshops through its W4C Supplier Partnership (WSP) model. This initiative aims to expand processing capacity, while empowering junkshops by upgrading their infrastructure, formalising informal waste workers, and enabling them to grow their businesses and improve waste management systems in Bogor, Depok, and Jakarta.

W4C primarily collects waste from businesses (offices, banks, and embassies) over households due to their higher willingness-to-pay and alignment with their corporate social responsibility and environmental, social, and governance (ESG) commitments. Customers are provided with separation bags to encourage wet and dry waste sorting, though separation is inconsistent.

Prior to the collaboration, waste collection processes were primarily manual, with modest capacity and informal data tracking. The partnership with WWF seeks to support improved operational efficiency, expand collection capacity, and contribute to the reduction of plastic leakage.

Objectives

- Collect 2,300 tonnes of plastic waste for recycling by June 2025.
- Establish three collection hubs by upgrading informal waste collectors in Bogor, Depok, and Bekasi.
- Set up pre-treatment facilities to process plastic waste into flakes.
- Implement a digital traceability system to ensure transparency and data-driven operations.

Key Successes

- **WSP Infrastructure Development:** W4C enhanced the waste processing capacity of eight junkshops by upgrading their facilities with roofs, equipment, personal protective equipment (PPE), and training on waste handling, health and safety, and digital data recording. These upgrades have helped create safer, more efficient workspaces and have enabled WSPs to grow their businesses, optimise operations, and increase processing capacity. This in turn has contributed to ensuring a more consistent material flow to W4C, supporting operational continuity beyond the grant period.
- **Revenue generation is progressing, with profitability anticipated as operations mature:** In its first year, W4C successfully generated revenue, including 5% from plastic sales. Additional income has been supported through plastic credit mechanisms and strategic partnerships such as with RECO for consistent feedstock. The business model is continuing to evolve toward long-term profitability.
- **Digital traceability system:** The internally developed digital traceability system enables real-time tracking of waste collection, transportation, and processing. This supports greater transparency and compliance with certification standards. Integrated system applications facilitate waste transactions, while plastic credits enhance traceability by verifying recovered and recycled materials. This has strengthened credibility with corporate partners and supported ESG-related reporting.

Key Challenges

- **Low shredding capacity impacts value recovery from materials:** At present, most plastic is sold in unshredded form (IDR 1,600–2,200/kg) rather than as higher-value shredded material (IDR 3,900–4,000/kg), due to processing capacity. While this helps avoid stockpiling and ensures material flow, opportunities remain to enhance value through expanded shredding operations.
- **Slower material turnover in some cases has resulted in stock build-up and potential financial exposure:** Where immediate market demand has not materialised, sales have been delayed, leading to temporary stock accumulation and possible depreciation. Strengthened monitoring and inventory systems are being developed to support more responsive management.
- **Adoption of internal systems is progressing at different paces among partner junkshops:** Some long-standing junkshops are in the process of transitioning to W4C’s standard operating standards, including traceability systems and worker welfare protocols. A monitoring framework supports this process and facilitates continued capacity building and alignment.
- **Flexible plastics continue to present transport and processing challenges:** Due to their nature, flexible plastics are more prone to material loss during handling and transport. This is a recognised area for ongoing operational refinement.



Resources

Support and infrastructure: WWF provided investment to support construction, facility upgrades, salaries, and procurement of key machinery such as blowers, shredders, and pre-treatment facilities for shredding and flake production to increase facility processing capacity to 150 tonnes/month.

Human Resources: There are 16 employees at the Bekasi facility, including project managers, administrators, waste collectors, facility operators, and data monitoring teams.

Stakeholder engagement: W4C collaborates with vetted WSPs who have sufficient capacity to sustain operations.



Enabling Factors

- **Blended financing:** Funding from different sources (private equity, development organisations, and market-based mechanisms including plastic credits) enabled W4C to expand its recycling operations, invest in infrastructure and equipment, and support waste worker livelihoods.
- **Eight junkshops upgraded** with machinery, PPE, and training on safety, sorting, and data management allow more consistent material supply for processing.

Risks & Opportunities

- **Testing blended finance models:** Providing successful financial models through blended finance for plastic waste management opens up the possibility for replication.
- **Policy around plastic crediting:** Governments to look at strengthening regulations to ensure better transparency and clarifying stakeholder roles.
- **Achieving long-term financial viability** will benefit from continued efforts to strengthen offtaker relationships and enhance operational efficiency. Exploring opportunities to expand beyond low-value plastics may also support improved market resilience and revenue diversification.



Case Study 3.3



Viet Nam: Cu Lao Cham

WWF Involvement: April 2021 to December 2022

Focus Area: Recovery and Recycling

PSC Approach: Recycling

Systemic Intervention:
Systems and Infrastructure



Key Lessons Learned

Cu Lao Cham: Small Island Scales Up Community MRFs

- **Geographic isolation calls for localised recycling solutions:** High transport costs and limited access to recycling markets present ongoing challenges for remote areas. Developing on-island recycling initiatives and forming partnerships with buyers can help create sustainable demand for recovered materials.
- **Selecting appropriately scaled equipment supports operational efficiency:** The mismatch between shredding and mixing machinery in small-scale island settings highlights the importance of choosing technology that is proportionate to local processing needs and volumes.
- **Building financial sustainability is key to strengthening long-term programme resilience:** Developing self-financing mechanisms – such as

incorporating waste management fees or generating revenue from recycled products – can help ensure programme continuity and reduce dependence on external funding.



Background

Cu Lao Cham, an offshore island in Viet Nam, covers nearly 76km² across 16 islands. The island has been a pioneer in implementing waste separation at source (WSAS) since 2009. Over the years, significant efforts and investments from the local government and non-profit organisations have focused on training residents to develop waste-sorting habits.

During the initial phases, the WSAS programme yielded positive results with strong community participation. However, in recent years, its effectiveness has declined.

Gaps in awareness and inconsistent waste handling at the disposal stage have continued to place pressure on the surrounding environment and ecosystems within the Cu Lao Cham – Hoi An World Biosphere Reserve.

To address these challenges, the People’s Committee of Tan Hiep Commune and the Management Board of Cu Lao Cham Marine Protected Area launched a pilot Material Recovery Facility (MRF) in Bai Ong village in 2020 receiving organic waste from 30 households (120 households in 2021),

followed by a second MRF in Bai Huong in 2022, serving 81 households (WWF, 2024b). Both these MRFs recycle organic waste through composting, recover high-value recyclable waste (metals, plastics and paper) and low-value plastics, and produce eco-detergent from fruit peels.

Recognising the positive results of the MRF model, the authorities of Tan Hiep commune collaborated with the Management Board of Cu Lao Cham Marine Protected Area to install a new MRF in Bai Huong village.

Objectives

- Implement a community-driven initiative to improve solid waste sorting and recycling across Cu Lao Cham Island.
- Replicate the MRF in Bai Huong and other areas based on two phases: a re-setting phase (i.e. improving the current MRFs’ efficiency) and a spreading phase (i.e. expansion of recycling activities and integration of more stakeholders).

Key Successes

- **Increased community participation and WSAS:** The MRF model has engaged local residents, creating active participation in waste sorting and recycling. Participation increased from 30 households in October 2021 to 200 in December 2023. Before the MRF, 70% of Bai Ong village sorted their waste at source, compared to 85% in 2022.
- **Technical improvements and value-added products:** Investments in technology, such as shredders for organic waste and equipment for multi-purpose detergents, have improved resource recycling rates and economic viability.
- **Organic waste recycling rates were initially low:** Before the introduction of suitable equipment, manual recycling processes yielded only 5 to 10% recycling of organic waste. Improved results have been observed following the integration of shredding technology.

Key Challenges

- **Reduction in plastic leakage:** The initiative contributed to 30 tonnes of leakage reduction over two-years, though further gains were constrained by logistical challenges, limited infrastructure, and equipment that was not always well suited to local conditions.

- **Absence of controlled disposal facility limits incentives for recycling:** The existing uncontrolled Eo Gio disposal site currently offers a lower-cost alternative to recycling, which reduces the comparative attractiveness of recycling. Advancing economically viable disposal infrastructure could help shift incentives in favour of recycling efforts.
- **Transportation and market access remain ongoing challenges:** Due to the island’s geographic isolation, transporting recyclable materials to mainland markets is costly and logistically challenging.
- **Workforce recruitment and retention presents difficulties:** Recruiting and retaining workers for waste collection and recycling is a continuing challenge, as the sector often faces low wages and physically demanding work.
- **Machinery alignment with operational scale requires further refinement:** Some equipment, such as shredding and mixing machines, has proven mismatched with the scale of current MRF operations, indicating an opportunity to further tailor technological choices to local needs.

Resources

Human Resources: Two workers in charge of collecting the sorted waste from households and operating the MRF.

Infrastructure: The MRF is 20m² and covered by a roof. It includes a composting area, detergent production and inorganic waste drop-off.

Stakeholders/Partnerships: WWF provided funding for the design and implementation of SWM concepts; the Global Incinerator Alliance, and [Pacific Environment](#) for the “Zero Waste Tour” with local schools.

Technology: Dry waste is composted in static piles; wet waste is put into compost bins with probiotics or worms. Some types of fruit peels are separated and reused to make multi-purpose cleaning detergent. All high-value and low-value recyclables are recycled or sold as scrap, and the remaining waste is transported to a centralised treatment facility for burning or to landfill.

Enabling Factors

- **Strong municipal leadership and cross-agency collaboration:** The initiative was led by the People’s Committee of Tan Hiep Commune in close cooperation with the Management Board of Cu Lao Cham Marine Protected Area. This partnership enabled clear institutional support and facilitated smooth implementation of the pilot and expanded MRF models.
- **Community ownership and phased rollout:** The project prioritised local involvement from the outset. By starting with 30 households and gradually scaling up to 200, the approach fostered familiarity and built trust, helping to improve participation rates from 70% in 2021 to 85% in 2022 in Bai Ong village.

Risks & Opportunities

- **Limited access to local recycling markets may affect financial viability:** The absence of nearby recycling industries means that materials must be transported to main islands for processing. Addressing this challenge through expanded logistics, partnerships, and scaling efforts could help improve economic feasibility.
- **Long-term financial sustainability remains a key consideration:** Ensuring continued viability will likely require diversification of income sources. At present, revenue from waste collection represents only 5% of total solid waste management system costs, highlighting the potential to strengthen financial mechanisms.

Case Study 3.4





Indonesia: Bogor
WWF Involvement: August 2023 to December 2024
Focus Area: Recovery and Recycling
PSC Approach: Recycling
Systemic Intervention: Systems and Infrastructure

Key Lessons Learned

Bogor: Bantar Kemang And Mekarwangi's Recycling

- Evidence-based planning is important for facilities, requiring accurate baseline data and material flow mapping, feasibility and risk assessments:** When facility planning is informed by up-to-date baseline data, including material flow mapping, equipment and processing capacity can be better aligned with actual waste volumes and composition. Carrying out a market assessment and strategy for recycled products, risk analysis, and financial planning in advance of implementation helps identify potential challenges and strengthens the project's long-term sustainability.
- Integrating facilities within the wider waste system improves overall efficiency:** Looking beyond the facility level to consider the broader solid waste management chain allows for greater coordination, avoids duplication, and enhances system-wide performance.
- Selecting equipment that matches material input and processing needs boosts performance:** When facilities are equipped with technology appropriate to incoming material types and volumes, productivity improves and output quality is enhanced.

 Background

Bantar Kemang and Mekarwangi are interconnected waste management facilities in Indonesia, owned by [Rekam Nusantara Foundation](#) who oversees the operations of both sites. WWF's partnership with Rekam Nusantara began in 2022. An area in Bantar Kemang, originally an illegal dumping site, was upgraded into a TPS (waste transfer and sorting facility) serving the surrounding neighbourhoods. While it could sell high-value plastics such as PET, PP, and PE, low-

value plastics such as multi-layer and single-layer plastics had limited offtakers, leading to the creation of Mekarwangi. Mekarwangi, a TPS3R recycling hub, was established to process low-value plastics from Bantar Kemang into various products. However, since becoming operational in 2024, it has had challenges with low production capacity, weak market demand, and financial instability. Both facilities have faced high capital and operational costs, poor waste separation at source, and unsustainable funding. While intended to create a closed-loop plastic recycling

system, systemic challenges have impacted efficiency, scalability, and long-term viability.

Objectives

- Transform an existing dumping ground into a functional waste transfer and sorting station (TPS) to improve local waste management.
- Establish financial sustainability through collection fees and material sales.
- Create a viable model for recycling low-value plastics into useful products.



Shredding Area - Mekarwangi

Key Successes

- **Mekarwangi produces recycled plastic products** such as infiltration wells, chairs, tables, and wood alternatives, showcasing the potential to reduce plastic pollution and generate value from waste. However, limited processing capacity prevents the facility from meeting the demand of its main customer, restricting its overall impact.
- **Bantar Kemang has undergone upgrades**, transitioning from an unregulated dumping ground into a basic transfer station. There is improved operational oversight and waste management controls.

Key Challenges

Bantar Kemang (TPS)

- **Ongoing challenges with enforcement have allowed non-designated waste to enter the facility:** While guidelines are in place, there are instances where waste from outside the permitted service area of 15 RTs continues to be delivered due to its strategic location, complicating efforts to monitor volumes and material composition (WWF KII 14, 2024).
- **Operational planning around waste flow and equipment could be further optimised:** More precise alignment between anticipated needs and equipment procurement would help avoid underutilisation and support more efficient operations.
- **Additional measures to improve containment at the vehicle offloading area may help reduce environmental impacts:** During periods of heavy rain, inadequate containment has occasionally resulted in waste being washed into nearby streets, highlighting opportunities for infrastructure improvement.

- **Low levels of source segregation continue to present processing challenges:** The presence of organic material and mixed waste in incoming waste streams complicates efforts to recover recyclable materials effectively.

Mekarwangi (TPS3R)

- Although established to process low-value plastics from Bantar Kemang, **the facility currently receives limited volumes of 3 tonnes/month**, which reduces its potential impact (WWF KII 14, 2024). Increasing the quantity and consistency of input materials would enhance its contribution to plastic recycling efforts.
- **The facility has yet to achieve full operational and financial self-sufficiency:** Despite notable capital and operational investments, revenue generation remains limited, partly due to emerging markets for recycled plastic products. Long-term sustainability may depend on the continued development of these markets and additional business planning support.
- **Production levels are currently constrained by processing capacity:** Although there is demand for products such as infiltration wells, the existing machinery limits the facility's ability to scale production to meet this demand.
- **Market demand for recycled plastic furniture is still evolving:** While the facility has demonstrated capacity to produce such items, broader uptake may depend on increasing awareness and creating targeted market linkages. More recently [PT Jauhar Hidro Mekatron](#) became an offtaker for some products.

 Resources

Support and infrastructure: Bantar Kemang received handcarts, PPE, and a motorcycle cart from WWF who also invested in equipment, including three conveyor belts, two shredders, two balers, an extruder, building and setting up of the facility in Mekarwangi. The land for Mekarwangi was also provided by Bogor Municipality and Bogor City Environment Agency to assist with set up and also receives significant support from the Ciliwung Task Force (Satgas Ciliwung) (WWF KII 14, 2024).

Human Resources: Bantar Kemang has nine employees, including a driver, security guard, sorter, supervisor and administration staff. Mekarwangi has a team of 11 employees with various roles, including management, operations, and technical support.

Stakeholders: Collaboration with local government for land and regulatory support.



 Enabling Factors

- The **allocation of land by local government**, access to sorting infrastructure, as well as technical expertise in plastic recycling and product development for Mekarwangi helped reduce initial capital costs and support the development of the project.
- The **largest supplier of waste comes from the Priority Rukun Tetangga (RT)** (a neighbourhood SWM unit), contributing approximately 80% of the total waste supply to Mekarwangi (WWF KII 14, 2024).

 Risks & Opportunities

- **Long-term financial sustainability of Bantar Kemang and Mekarwangi remains uncertain:** With current revenue levels not yet sufficient to fully sustain operations. Low community participation in waste separation may affect processing efficiency, and challenges with enforcement could allow for continued unregulated dumping. Mekarwangi's efforts to build consistent market demand for recycled products are ongoing, and demand remains relatively low at this stage.
- **Stronger enforcement from local city leaders:** Collaborate closely with Bogor City Environment Agency to enforce clearly assigned neighbourhoods to dispose of segregated waste to Mekarwangi and Bantar Kemang to ensure steady source of waste and increase recycling rate.



Melter & Moulding Area - Mekarwangi

Sample recycled plastics product

Case Study 3.5





© WWF-Philippines

Philippines: San Isidro

WWF Involvement: October 2022 to December 2024

Focus Area: Recovery and Recycling

PSC Approach: Community-based Waste Management

Systemic Intervention: Systems and Infrastructure

Ice Breakers at Virtual Training

Key Lessons Learned

- Multi-stakeholder collaboration strengthens system resilience:** Involving local government, community leaders, women’s groups, and waste worker cooperatives has helped create a more inclusive and integrated solid waste management system. These partnerships have been instrumental in building local ownership and supporting long-term sustainability.
- Strategic infrastructure placement supports efficient operations:** Locating waste management facilities with transport logistics, worker accessibility, and material flow in mind can improve system efficiency and reduce operational costs by minimising unnecessary transport and handling.
- Integrating social inclusion policies requires sustained advocacy:** The Gender and Plastic Policy Ordinance represents meaningful progress in protecting waste worker rights. However, bureaucratic delays have shown that policy adoption can be slow, reinforcing the importance of ongoing advocacy and planning for transitional measures.

Sorting of Recyclables



© WWF-Philippines

 Background

This initiative focuses on enhancing waste collection, processing, and value recycling to improve integrated solid waste management while promoting social inclusion and gender equity in San Isidro’s waste sector.

The city waste baseline assessment carried out through this project in 2021 revealed that out of the 30 tonnes of municipal solid waste generated daily in San Isidro, only 8% was collected, 15% of the waste was plastic, which had a

recycling rate of only 13%. Solid waste from all 16 barangays are brought to the landfill, where residuals are disposed of in the Residual Containment Area (RCA) and some recyclables are sorted in the central material recovery facility (MRF), located in the RCA.

To tackle low collection services and recycling rates and support the ‘no segregation, no collection’ policy, WWF provided critical infrastructure, including motorcabs for waste collection and a centralised MRF in San Isidro to improve waste segregation and recycling efficiency.

Waste collected by the Barangay La Union for example, is transported to the MRF, where members of Bituing Marikit Rural Improvement Club (BMRIC) — an informal waste worker group — sort, bale, and either sell or upcycle the materials

A key component of this initiative is the integration of waste workers with the San Isidro Municipal Women’s Association (SIMWA). Upcycled products created from recovered plastics into plant pots and purses/bags by BMRIC members are handed over to SIMWA, who was trained by this project in

marketing, business, and product development. As many waste workers are also members of the women’s group, this collaboration strengthens economic opportunities by linking waste recycling with livelihood opportunities. The initiative underscores the importance of human rights and social equity in addressing plastic pollution.

Objectives

- Strengthen waste collection and recycling systems in San Isidro through targeted infrastructure support.
- Influence policy-makers to include gender inclusion and social equity in San Isidro’s SWM system.



Sorting of plastic caps by color



End product: upcycled Plastics coaster

Key Successes

- **Establishment of a centralised MRF and provision of infrastructure** and vehicles (motorcabs) to Barangay La Union, enabling their collection of waste. The location of the central MRF at the landfill and RCA allows for greater operational efficiency.
- **Provision of waste management and repurposing infrastructure** and training to BMRIC and SIMWA for turning plastics into other products.
- **Training SIMWA members** in marketing, business, product development and proposal development which led to their securing of other grants.
- **A Gender and Plastic Policy Ordinance** for the BMRIC waste workers was drafted in 2022. The Ordinance supports a gender inclusive SWM system, declaring incentive systems, appropriating funds and other related purposes. Even though the ordinance is still under review by the committee, the local chief executive started providing waste workers with a monthly honorarium and personal protective equipment as a result of this advocacy.

Key Challenges

- **Expanding collection coverage and infrastructure continues to present operational considerations:** While improvements have been made, reaching currently underserved areas remains an area for further development, influenced by political dynamics and logistical conditions. For example, some of the existing collection equipment has not yet been optimally matched to the waste volumes along certain routes.

- **Collection equipment capacity** is smaller than route demands;
- **Narrow access roads** present challenges for the use of larger transport vehicles;
- Some **areas remain difficult to service** due to terrain or infrastructure constraints;
- **Continued investment** is needed to strengthen and extend service networks;
- **Political and institutional coordination** processes can hinder expansion timelines.
- **Lengthy review of ordinance:** The draft Gender and Plastic Policy Ordinance reflects an encouraging step forward. However, the approval process has progressed gradually, particularly in the context of upcoming municipal elections.
- **Encouraging social acceptance and participation remains a longer-term goal:** Collaborating with SIMWA (a women-led waste group) has generated meaningful economic opportunities. However, social stigma toward waste work continues to influence how community members perceive the sector. In some cases, outdated gender norms have affected recognition of female workers’ roles. Encouraging broader participation in waste segregation will benefit from continued community engagement, inclusive public education campaigns, and efforts to raise the visibility of SIMWA’s contributions.
- **Creating stable markets for upcycled products is key to financial resilience:** The project’s financial sustainability is closely linked to demand for its upcycled plastic products. Ongoing efforts to expand market reach and increase product appeal will be essential to ensure long-term revenue generation and impact.

Resources

WWF Support: Provision of motorcabs for collection, training in marketing/business development for SIMWA members, ordinance draft, a sorting and storage area for recyclable materials, baling machine, melter, moulder for coasters and flower pots.

Partnerships: Community leaders, SIMWA, BMRIC, MENRO (public collection service provider).

Enabling Factors

- **Strategic MRF placement:** Locating the central MRF at the landfill and RCA optimises efficiency in waste transportation, sorting and disposal.
- **Multi-stakeholder collaboration:** Partnerships with community leaders, women's associations, public collection services, and informal waste worker groups have strengthened social inclusion and operational effectiveness.
- **Active civil society:** Linking waste collection and recycling to livelihood opportunities via SIMWA and BMRIC helps create an integrated solid waste management (SWM) system and raise awareness amongst the local communities.

Risks & Opportunities

- **Equipment compatibility:** Operational inefficiencies may arise if systems for collection, transfer, sorting, and disposal are not well-aligned – this could lead to higher costs, delays, and reduced recycling rates. For example, the motorcab provided to Barangay La Union was too small for the amount of waste to be collected along its collection route, requiring 3 trips to complete its round.
- **Financial uncertainty:** Reliance on external funding for equipment and waste worker incentives may hinder long-term sustainability if financial support is not secured.
- **Strengthened business models for upcycled goods:** to help ensure that recovered plastic and other materials are turned into value-added products with real market demand for sustainability.

- **Regulatory delays:** Without formal political engagement and adoption, policy proposals may remain unfulfilled.
- **Local Government unit buy-in of ordinance:** follow-up on the Gender and Plastic Policy Ordinance can support the formalising, institutionalising and scaling of plastic waste recycling activities with a just inclusion.
- **Community buy-in and behavioural change:** If local communities do not fully participate in waste segregation and recycling efforts, the impact of the initiative may be limited.

Washing of plastic caps for drying and shredding

Women melting plastics using the injection molder machine

Plastic coasters can also be used as lei of visitors, guest during events





Enabling Framework

4 Enabling Framework

☆ Introduction

It is crucial to look at the solid waste management (SWM) support system of an initiative when designing, approving, implementing, and supporting it to ensure long-term success. This support system is referred to as the enabling framework, shaping the overall context in which an initiative exists. It can be characterised by understanding the institutional, legal, technical, environmental, financial and social aspects.

The framework conditions determine how the initiative functions in practice and how it can be developed in a specific context. Where SWM systems align with enabling conditions, they can scale more easily. Where they are misaligned, they face barriers to implementation, replication and long-term viability. Understanding the enabling framework conditions brings security of direction to invest in a specific initiative or technology.

The PSC programme has emphasised the importance of a [strong enabling framework](#) to ensure long-term impact. Interventions have focused on policy and regulation, sustainable financing mechanisms, and robust monitoring and assessment to support systemic change.

This section presents four case studies, shown in Table 5.

		
Local Policy and Regulation Case Study Country (City/Site) 4.1 Hue’s City Action Plan for Clean Streets Viet Nam (Hue)	Sustainable Financing Case Study Country (City/Site) 4.2 Improving the Financial Sustainability of Thailand’s MRFs Thailand (Surat Thani and Songkhla)	Monitoring and Assessment Case Study Country (City/Site) 4.3 Addressing Plastic Leakage with Data in Cagayan de Oro Philippines (Cagayan de Oro) 4.4 Indonesia Waste Banks Go Digital Indonesia (Jakarta, Bogor, Depok)

Table 5. Summary of case studies in the ‘Enabling Framework’ stage

☆ **Summary**

To maximise impact, policy, finance, and data systems should work in tandem. Strengthening regulatory enforcement, embedding financial sustainability within national policies, and investing in monitoring and evaluation are essential to ensuring long-term progress. By encouraging cross-sectoral collaboration, and leveraging data for adaptive management, cities can build resilient waste management systems that drive systemic change and accelerate the transition towards a circular economy.

📄 **Local Policy and Regulation**

Without the right policy and regulations, even the most promising waste management solutions struggle to scale. The legal framework is the most important foundation that gives direction to each waste generator and manager for each material/waste stream. Policy mechanisms support this by targeting specific challenges and to initiate and sustain system improvements. Understanding the current situation – what are the elements of the system, how they are performing, who is in charge, what are the material flows, what are the barriers/limiting factors, etc. – is the starting point for policy formulation. Additionally, policies and regulations on single-use plastic bans for example would also support direct reduction of waste generation and reduce the burden on collection and recovery systems.

In the absence of strong policy frameworks, financing mechanisms, and evidence-based decision-making, even well-designed interventions may face challenges in achieving lasting change. Hue, Viet Nam ([Case Study 4.1](#)) illustrates how clear policy direction, combined with phased implementation and strong public engagement, can support reductions in plastic waste leakage. However, policy

alone may not be sufficient – complementary enforcement mechanisms such as fines, bans, and economic incentives can further support compliance and promote sustained behavioural change.

💰 **Sustainable Financing**

Financial sustainability is the cornerstone to ensure sustained operations and scale solutions. A sustainably financed system has a balance between the total costs and the total revenues:

- **Capital Expenditure (“CAPEX”)**, which involves the initial costs to buy equipment or build infrastructure; and
- **Operational Expenditure (“OPEX”)**, involving running operational costs and service maintenance (labour, fuel, servicing of the equipment).

PSC programmes have explored models such as financial incentives and blended finance, with the potential for incentives to enhance the recycling and processing of plastic waste, principally to stimulate separation at source in order to improve material quality going to MRFs, integrating stakeholders across the value chain and increasing participation in waste banks.

Financial sustainability remains a key challenge for many initiatives. The Thai Ocean Plastic Recycling (TOP) project in Thailand ([Case Study 4.2](#)) highlights the importance of targeted financial incentives in reducing operational costs and driving private-sector participation. It has managed to lower costs from USD 482 per tonne to a projected USD 148 per tonne in 2025, demonstrating the potential of incentive-based models (WWF, 2024). However, reliance on temporary subsidies highlights the

need for long-term economic instruments such as landfill pricing, product taxes, and mandatory EPR contributions to ensure stable revenue streams and prevent funding gaps. See more about WWF’s approaches to EPR [here](#), including [WWF’s EPR position paper](#).



© WWF-Indonesia

 Monitoring and Assessment

Monitoring and assessment play a crucial role in tracking progress against a baseline, identifying gaps and key interventions, enabling evidence-based decision-making essential to tracking performance, guiding investments, and adaptive management. Setting SMART (Specific, Measurable, Achievable, Relevant and Timely) indicators ensures that goals are realistic, consistently tracked, and interventions can be adjusted as needed to maximise impact.

The comprehensive baseline assessments in Cagayan de Oro, Philippines ([Case Study 4.3](#)) provided insights into plastic leakage points and waste generation patterns, guiding more strategic interventions. The [Waste Wise Cities Tool](#) (WaCT) – or the similar Waste Composition Survey (WACS) in the Philippines – and the [Waste Flow Diagram](#) (WFD) were

used. The WaCT is UN-Habitat’s methodology to monitor the Sustainable Development Goal (SDG) target 11.6.1, focusing on the amount of municipal solid waste collected and managed in controlled facilities, while the WFD aims to quantify plastic leakage from the SWM system.

Additionally, the [Wasteaware ISWM Benchmark Indicators](#) (WABI) methodology profiles the performance of a SWM system situation, including governance aspects, and provides a basis for prioritising and articulating goals. Stakeholder engagement is critical to ensuring that the policy goals are implementable in practice.

To measure the overall impact of interventions, most PSC sites follow the [Plastic Smart Guide for Cities](#), conducting a baseline and an endline assessment using these methodologies to ensure comparability of the results. For

the monitoring of individual interventions, each project develops their own monitoring tools, adapting to the local needs. The PSC programme also has a [City Impact Monitoring Platform](#) available to internally see the overall status of the PSC’s progress towards plastic leakage reduction within each city and the contribution by specific interventions.

Other digital monitoring tools such as Indonesia’s AKSI digital platform ([Case Study 4.4](#)) illustrates how digitised systems can enhance transparency and operational efficiency in waste bank management. However, digital transformation faces adoption challenges in communities unfamiliar with digital tools, reinforcing the need for ongoing training and intuitive system design. Other examples of leveraging digitised systems for monitoring and assessment can also be seen in [Case Study 2.3](#) (Blockchain Technology in Manila) and [Case Study 3.2](#) (Waste4Change Digital Traceability Systems).



© Julian Hahne / WWF-Indonesia

4.A

Local Policy and Regulation

Recommendations



 National Government	Regulatory Frameworks: • Set up an enabling regulatory, legal, institutional and financial framework to ban or regulate certain high-risk plastic products and ensure complete waste collection services coverage and environmentally sound management of plastic waste. Legal frameworks that acknowledge that waste is a resource can assist in encouraging reuse and recycling for the transition towards a circular economy (UNEP, 2024). Policy Implementation: • Implement and expand EPR: Strengthen and expand EPR schemes to improve financing and diversify revenue streams for waste and resource management and set material-specific recycling targets for producers. Set gradual compliance targets to enforce nationwide implementation of waste separation at source (WSAS) with clear guidelines for households, businesses and institutions. A phased approach with increasing recycling and recycling targets, similar to South Korea’s annual mandatory recycling rates under EPR (Prevent Waste Alliance, 2020). • Establish national measures to improve ISWM: Countries can put in place bans, restrictions, permitting requirements, and control mechanisms that align with local waste and resource management challenges and capacities.	 Local Government	Quick-win Policies: • Prioritise immediately actionable measures and ‘no-regret investments’ (e.g., banning or regulating certain high-risk plastic products, enforcing better segregation at source, expanding collection points) to demonstrate success quickly and build political momentum. Organic Waste Management: • Scale up organic waste recovery initiatives and encourage decentralised organic waste recovery to reduce landfill dependency and promote soil health. Separating organic waste at source also reduces contamination in the dry waste stream, resulting in cleaner recyclables.
	 Producers	Policy Adoption: • Comply with EPR legislation and waste separation policies. • Contribute to national and local policy dialogues to sup	
	 Operators/ Recyclers	Compliance and Collaboration: • Operate in compliance with national waste regulations. • Collaborate in the design of local waste separation, collection, and processing guidelines	
	 Civil Society	Policy, Advocacy, Communications: • Advocate for inclusive policies recognising the role of informal sector and community recyclers. • Raise awareness about regulations and citizens’ responsibilities.	

Table 4. Recommendations for supporting the enabling framework

4.B

Sustainable Financing

Recommendations



 National Government Policy Implementation: • Mandate EPR across plastics, electronics, and textiles, incorporating eco-modulation of fees to reward easily recyclable or low-impact products. A well-designed EPR scheme also stabilises recycling markets, reducing price volatility, and encouraging investment in eco-friendly design and recovery infrastructure. Fees and Levies: • Impose fees on waste disposal and virgin materials to reflect environmental costs, discourage waste generation, and channel revenues into SWM services. • Set minimum purchase prices for recycled products and levy a “plastic tax” on virgin polymers to maintain a cost premium for sustainable materials. Incentives: • Provide subsidies and grants for recovery initiatives to bridge early-stage viability gaps and stimulate market entry.	 Producers EPR Contributions: • Financially support EPR schemes and contribute to infrastructure for waste recycling. • Innovate in product design to enhance recyclability.
	 Operators/ Recyclers Facility Financing: • Use blended financing to gradually improve facilities and equipment: To adapt to variations in waste streams. • Ensure long-term financial planning by balancing CAPEX with OPEX considerations. While CAPEX costs are often supported through grants, donor funding, or partnerships, sustainable OPEX require dedicated strategies to cover ongoing operational expenses, which are often the more significant long-term challenges.
 Local Government Diversify Income Streams: • Introduce additional economic instruments (e.g., landfill pricing, product taxes, etc. to assist in restructuring financial flows and generating revenue to support the transition to a circular economy. This requires complementary legal and regulatory measures and successful enforcement mechanisms to be implemented to support these initiatives. Policy Implementation: • Support local implementation of EPR-funded initiatives and partnerships.	 Civil Society Multi-stakeholder collaboration: • Create partnerships with downstream processing capabilities: Such as end-of-chain recyclers (e.g. flake or pellet production), is vital to enhance access to markets for recycled materials to build revenue.



4.C

Monitoring and Assessment

Recommendations

 National Government	Monitoring Systems Design: • Define measurable indicators such as reduction in plastic generation, recycling rates, plastic leakage reduction, and waste diversion from landfills to track how progress is being made towards these indicators. • Develop national standards/norms for waste separation (organic, dry recyclables, residuals, hazardous) to ensure uniformity across provinces and cities. Application Programming Interface (API) Integration: • Open API systems should be developed to enable seamless data sharing and interoperability between platforms, enhancing coordination across stakeholders and maximising the impact of collected data.	 Producers	Data Transparency: • Share waste volumes and recycling data through digital platforms. • Track and share material flows and performance of EPR targets using CDP's disclosure platform.
		 Operators/ Recyclers	Capacity Strengthening: • Provide training for staff/waste workers on data collection, entry, and management.
 Local Government	Evidence-Based Decision-Making: • Set specific performance targets: For plastic leakage reduction, waste diversion, and recycling rates. Align these targets with broader national goals, regional environmental agreements, and local waste management strategies to drive action. • Adaptive monitoring and data driven decision-making: For evaluating and optimising ISWM initiatives. Conduct comprehensive baseline assessments and implement effective data collection and recording systems to help improve monitoring protocols and provide a basis for data evaluation and adaptive management.	 Civil Society	Knowledge Strengthening: • Engage in citizen-led data collection and validation. • Support training and capacity-strengthening on monitoring tools and waste assessments.

Case Study 4.1





© WWF-Viet Nam

Viet Nam: Hue

WWF Involvement: September 2022 to December 2024

Focus Area: Enabling Framework

PSC Approach: Local Policy and Regulation

Systemic Intervention: Strategy Development / Policy Advocacy

Key Lessons Learned

- **City adoption and monitoring of a City Action Plan allows for adaptive management, strengthening implementation through real-time learning:** strong support from local municipalities and active supervision and responsive adjustments contribute to better results on the ground. For instance, early confusion around bin use led to misplaced waste, prompting the project to recommend design modifications – an example of how small, timely adaptations can improve clarity and reinforce programme goals.
- **Coordinated timing of activities maximises impact and avoids inefficiencies:** Providing a system of separation bins, waste bags, and green houses worked most effectively when aligned with training sessions for local government officials, residents, and schools. Rolling

out activities in a synchronised and logical sequence – such as delivering training and local government enforcement when equipment is distributed – may ensure understanding and avoid duplication of efforts.

- **Behaviour change is a long-term process that benefits from continuous support:** Encouraging waste separation at source requires ongoing advocacy, consistent engagement from public authorities and civil society, and dedicated resources. While policies and regulations play a role, their effectiveness is significantly enhanced when combined with awareness raising, training, and community capacity building.

 Background

The [journey towards “Hue – A Plastic Smart City in Central Viet Nam”](#), started with conducting baseline studies guided by the Plastic Smart Cities’ (PSC) [Plastic Smart Guide for Cities](#), to assess the current state of solid and plastic waste management, identify relevant stakeholders and crucial interventions. Accordingly, community consultations and interviews with national and international experts were conducted to develop a City Action Plan (CAP) for 2022 to 2025.

The CAP sets specific targets to reach the overall goal: reducing plastic waste leakage into the environment by 30%. To achieve such a goal, Hue City’s People’s Committee issued the CAP (Plan No. 1121/KH-UBND) on 22 February 2022, which describes the implementation and management of plastic waste in Hue city by 2025, with a vision to 2030.

The plan states that plastic waste management is a part of integrated solid waste management (ISWM) and is a shared responsibility of society, with the State playing a leading role. Key measures of the CAP include increasing plastic

waste collection at fixed points, promoting recycling and safe disposal of solid waste, minimising single-use plastics (SUPs) and raising public awareness of environmental protection. This will be realised through increasing investment, promoting socialisation and maximising all possible resources.

Objectives

- Support Hue city to protect the rivers and ecosystems of wetlands and coastal areas from being polluted by plastic waste.



Key Successes

- **Phased Implementation for Measurable Impact:** The CAP was rolled out in stages, including strengthening communication, training, plastic waste separation at source and building pilot models such as “Plastic waste free school” and “plastic waste reduction market”.
 - **Phase 1:** Implemented in six wards, reducing plastic leakage by 72 tonnes.
 - **Phase 2:** Expanded to 18 wards, reducing plastic leakage by 392 tonnes.
 - **Phase 3:** Reached 19 wards, achieving a total reduction of 570 tonnes.
- **Targeted Infrastructure Deployment:**
 - **272 dedicated bins** were distributed for safe disposal of pesticide packaging, reducing agricultural plastic waste.
 - **100 large net bags** were provided to fishermen to support the collection of ocean-bound plastics and fishing gear waste.
 - **6,000 households and 101 schools participated** in participatory action-oriented training (PAOT) on waste separation at source (WSAS), plastic waste reduction in schools and in daily life, encouraging long-term behavioural change.
- **Implementation of integrated SWM principles:** By promoting the collection, sorting, and recycling of plastic waste, the initiative contributed to the development of local collection services and recycling markets, supporting an integrated development of the SWM system.

Key Challenges

- **Coordination timing and implementation delays:** Effective coordination among stakeholders, including local authorities, businesses, and civil society groups, required significant effort. Aligning schedules, responsibilities, and resources often led to delays in rolling out initiatives.
- **Sustaining public engagement:** Encouraging long-term behaviour change in WSAS proved challenging. While initial enthusiasm was high, maintaining participation required continuous advocacy, incentives, and public outreach.
- **Limited financial resources and incentives:** The transition away from single-use plastics and implementing sustainable waste management practices required financial support. Many businesses and households hesitated due to the additional costs associated with alternatives and waste separation.



Resources

Support: WWF funded city-wide waste separation facilities and equipment, including public trash bins, bins for the households, and two compactor trucks.

Human resources: WWF staff provided training for officers in 36 wards/communes and neighbourhood groups, as well as intensive technical support and funding for 18 pilot wards/communes.

Partners/stakeholders: The project supported key local organisations, including the Women's Union, Veterans' Association, Farmers' Association, Fishery Association, and Thuan An Fishing Port, in conducting outreach and awareness campaigns on WSAS. The Hue City People's Committee was the beneficiary and executive agency.

Enabling Factors

- This initiative had **active participation** from the entire community, involving local authorities and stakeholders in coordinating the collection, transportation, and waste recycling stages.
- The **baseline assessment** (which included the application of the [Waste Wise Cities Tool](#) and [Waste Flow Diagram](#) methodologies) helped with driving evidence-based decision-making and targeting key interventions with a higher chance of impact.
- The CAP had **clear targets** to ensure alignment with national/municipal SWM strategies.
- Substantial **funding** assisted the city in procuring collection equipment and organising communication campaigns to ensure lasting change.

Risks & Opportunities

- Shifting political priorities and varying levels of policy support:** Changes in political leadership may influence the continuity of support for the CAP, as priorities evolve. In some cases, enforcement mechanisms may not yet be fully established, which can affect adherence to waste reduction policies. Continued engagement with local authorities on this topic will support further sustainability of operations.
- Baseline assessments:** If they are inadequately detailed or become outdated due to prolonged intervals between data collection and implementation, there is a risk that interventions may no longer align with current needs, particularly in rapidly evolving solid waste management environments. Building in regular assessments on the city's waste flow into future plans will ensure adaptive management where needed.
- Coordination among stakeholders remains a complex task:** City authorities, private sector actors, NGOs, and communities may hold differing priorities or expectations, which can pose challenges for unified planning and implementation. Further organisation of multi-stakeholder consultations may support coordination & alignment.
- Funding constraints and financial sustainability considerations:** Constraints in budget allocation for waste infrastructure, incentives, and awareness campaigns may affect the timely implementation of the CAP. In addition, continued reliance on donor funding without a clear long-term financing strategy may present risks to programme continuity, thus requiring diversification of funds potentially through EPR or city allocation.



Case Study 4.2



Thailand: Songkhla and Surat Thani

WWF Involvement: October 2023 to December 2024

Focus Area: Enabling Framework

PSC Approach: Recycling

Systemic Intervention:
Financing and Funding Mechanisms

Improving the Financial Sustainability of Thailand’s MRFs



- **Leveraging private sector partnerships can accelerate and scale impact:** Collaborating with companies involved in material processing and waste collection has shown strong potential to expand project outcomes. The use of existing infrastructure and distribution networks can significantly enhance plastic recycling efforts.
- **Tailored economic instruments support context-specific market transformation:** Applying a locally adapted pricing strategy that subsidises plastic collection and processing helps reshape Thailand’s plastic market in the short term. This approach supports system viability until plastic material values become more competitive and Extended Producer Responsibility is established. This solution is specifically adapted to Thailand’s plastic market.

- **Diversified revenue models can strengthen economic sustainability:** Partnerships with businesses that generate income from multiple streams—such as collection services, material sales, and recycling—demonstrate that solid waste management systems can be both environmentally and economically sustainable, increasing their appeal to investors.



Background

In many Thai cities, the costs associated with collecting and processing plastics often exceed the market value of recyclable plastic. In Songkhla, lower market prices are influenced in part by challenges related to material quality, including contamination. This results in a need for additional sorting, cleaning, and pre-processing before materials can meet the standards required by offtakers.

These conditions highlight the importance of ongoing systemic improvements – such as enhanced separation at source – to increase the quality of recyclables and improve

overall efficiency. They also point to the potential value of continued financial support for material recovery facilities (MRFs) to enable them to operate sustainably and move towards profitability.

In order to increase the amount of plastics collected and recovered in Surat Thani and Songkhla, two MRFs were established under this project implemented with [Thai Ocean Plastics](#) (TOP). TOP collects, sorts and recycles [Ocean-Bound Plastics](#) and is currently managing a first MRF facility, located in Surat Thani and operated by ENG Consultant Co., Ltd. Another MRF facility is operated by CGS Supply and Equipment Service Co., Ltd in Songkhla. To boost low-

value plastics recovery, MRFs received financial incentives to accept materials from waste banks and pickers, ensuring these plastics are processed rather than discarded.

End-to-end interventions were enabled across the plastic supply chain by collaborating with ENG and CGS to optimise their facilities and enhance their effectiveness in working with small-and-medium-sized suppliers (i.e. junkshops). TOP provided a fixed incentive mechanism directly to the MRFs, in order to increase the volume of materials flowing through their facilities and make a profit from the sales of more materials. Collectors in Surat Thani and Songkhla receive a fixed incentive aligned with WWF’s project budget.

Objectives

- Increase plastic waste collection and recycling by stabilising the market and creating a sustainable price structure, particularly as Extended Producer Responsibility (EPR) support is anticipated in the coming years.
- Stabilise the market through the implementation of an incentive mechanism.

Key Successes

- Between October 2023 to December 2024, over **1200 tonnes of plastics collected, including:**
 - Over **720 tonnes of plastic recovered by ENG**, above their target of 500 tonnes;
 - Over **510 tonnes were collected by CGS** above their 500 tonnes target.
 - The above included over 10 tonnes and 8 tonnes of non-recyclable low-value plastics, respectively.
- **Operational efficiency gains** have led to a reduction in the cost per tonne for processing and collection at the MRFs. Costs decreased from USD 482 in 2023 to USD 351 in 2024 and are projected to reach USD 148 in 2025 as processing volumes increase and systems are further optimised.



Key Challenges

- **Material quality and source separation practices influence processing efficiency:** Mixed waste streams require additional sorting from general plastic waste. For instance, oil bottles must be cleaned, while green tea bottles often have printed screens that, once removed, increase their sale value. These additional steps, while adding value, also require more sorting time and labour. Current separation practices at the city level present ongoing opportunities for improving operational efficiency.
- **Collection service coverage affects facility throughput:** The volume of materials reaching the TOP facilities is shaped by the extent of current collection services connecting to the MRFs. As a result, facilities are not yet operating at full capacity, suggesting potential benefits from expanding and optimising the collection service.
- **Distance and financial feasibility influence partnership opportunities:** Oxytech, a flake production facility located in Krabi, was considered for sorting and washing. However, the geographical distance between CGS and Oxytech presents logistical considerations on transportation cost.

Resources

Support: The incentives provided to TOP were funded by WWF, who also provided operational support to TOP, including funding the rent of two MRFs, and provision of horizontal baling machines, loaders, and incentives. The incentive scheme provides 3.5 THB/kg to support plastic collection and transport. The goal is to stabilise the market by ensuring a predictable price structure, to reduce financial risks for waste collectors while increasing material recycling rates.



Partners/stakeholders: TOP, local junkshops, end-of-chain recyclers for low-value plastics (e.g. bottle-to-bottle recycling, fiber manufacturing sectors, flake production with Oxytech), premium market offtakers in Bangkok.

Enabling Factors

- **Network Effectiveness:** The integration with key players for collection, recycling and end-of-chain recyclers can position MRFs to address gaps in the value chain, and scale as a complete supply chain solution.
- **Operational strength:** An MRF's strong performance highlights the scalability of existing operations. Expanding the capacity of other local MRFs may help improve regional performance and balance recycling outcomes.
- **Market stabilisation:** Continued support to improve sorting for low-value plastics and reduce leakage strengthens the MRFs' resilience against market fluctuations and reduces dependency on incentives.

Risks & Opportunities

- **Market stabilisation and dependency on incentives** could be mitigated through scaling operations in underperforming areas, enhancing logistics, and leveraging partnerships to optimise the full supply chain from collection to processing and offtake.

Case Study 4.3





© AMH Philippines, Inc.

Philippines: Cagayan de Oro

WWF Involvement: May 2023 to November 2024

Focus Area: Enabling Framework

PSC Approach: Monitoring and Assessment

Systemic Intervention: Knowledge Strengthening

Key Lessons Learned



collected PET Bottles at an Aggregator

Household waste Management Practices Survey

Addressing Plastic Leakage with Data in Cagayan de Oro

- Baseline assessments are critical for strategic planning:** The use of data collection tools such as the Waste Analysis and Characterisation Study (WACS), Waste Wise Cities Tool (WaCT), Waste Flow Diagram (WFD), and Knowledge, Attitude, and Practice (KAP) surveys provided essential baseline data to inform decision-making. These tools enabled the development of interventions aligned with national waste reduction goals, including improvements in source separation and material recycling.
- Recycling infrastructure is key to achieving waste diversion targets:** The absence of local recycling facilities limits the effectiveness of waste segregation at the community level and interrupts the full waste stream cycle. Establishing this infrastructure is essential for supporting diversion from landfill and extending the lifespan of the sanitary landfill.



© AMH Philippines, Inc.

 Background

Cagayan de Oro City is a major urban centre in the Philippines. In 2024, the city generated around 450 tonnes of municipal solid waste (MSW) per day, of which 18% was plastics (80 tonnes). Its coastal location, nearby 12 major waterways, and high population of 775,540 make it particularly vulnerable to plastic waste leakage into marine environments, with unmanaged plastic waste (sum of uncollected and

leaked plastic waste from the MSW management system) representing 11% of the total plastic waste generated (AMH Philippines Inc., 2024).

Following PSC’s [Plastic Smart Guide](#) for Cities, the city conducted a baseline in 2024, including a Waste Analysis and Characterisation Study (WACS), [Waste Wise Cities Tool](#) (WaCT), [Waste Flow Diagram](#) (WFD), and Knowledge, Attitude and Practice (KAP) surveys. The baseline assessment played a central role in identifying waste generation sources, recycling gaps, and leakage points.

Objectives

- Quantify waste generation and composition at household and non-household levels and assess waste collection, recycling and disposal to provide data to update the city’s ten-year SWM plan (2018 to 2027).
- Identify sources and pathways of plastic waste leakage and recommend improvements in waste management infrastructure.
- Increase community participation in waste separation through behavioural change initiatives and incentives.

Summary

Introduction

Reduction1

Collection2

Recovery & Recycling3

Enabling Framework4

Replication & Scaling

Investing in CE

 Key Successes

- Baseline data directly informed the **update of Cagayan de Oro’s ten-year SWM plan**.
- **High community willingness:** 95% of the 67 surveyed households expressed willingness to participate in environmental programmes, increasing to 97% when incentives were provided. Additionally, 55% of households adopted waste separation practices after targeted awareness campaigns, contributing to increased waste recycling rates.
- **Waste Diversion:** Establishment of barangay MRFs and centralised recycling systems. About 50% of the city’s barangays now have functional centralised MRFs, leading to increased diversion of recyclables from landfills, particularly PET and HDPE plastics.
- **Plastic Leakage Reduction:** Data-driven decision making allowed for a combination of improved collection routes, recycling programmes, and trash traps, reducing annual plastic leakage by preventing 4.8 tonnes of plastic waste from entering water systems.

 Key Challenges

- Instances of **waste mixing during transport** were observed, as collection vehicles were not compartmentalised. This affected the overall effectiveness of segregation efforts and highlights an opportunity to strengthen alignment between source separation and transport systems.
- **Modest reduction in plastic leakage despite efforts:** While the introduction of improved collection systems, targeted recycling initiatives, and trash traps has contributed to reducing plastic leakage, the estimated **4.8 tonnes/year** diverted from waterways suggests that

further scaling and reinforcement of these measures may be needed to achieve more substantial impact.

- **Plastic leakage:** WFD results indicate that 45% of unmanaged plastic waste originates from uncollected waste, while 35% is lost during collection and transport. Addressing service gaps and improving logistics could help mitigate this issue.
- **Policy implementation gaps:** Although local policies support waste segregation, enforcement and monitoring remain inconsistent. Enhancing policy implementation and compliance mechanisms could further strengthen outcomes, using initiatives such as “no segregation, no collection”.

 Resources

Support: WWF supported with funding and management of the baseline assessment, multi-stakeholder collaboration, creating a stronger feedback loop between government entities, private recyclers, and communities.

Baseline tools: The WACS provided quantitative data on waste generation and composition, the WaCT provided data on collection, recycling, and disposal, and the WFD assessed leakage points. The KAP surveys and awareness campaigns encouraged community involvement in waste management activities - all were fundamental for baseline data collection.

Community Engagement: Public awareness campaigns and surveys to understand community needs and design targeted interventions.

 Enabling Factors

- **Monitoring of waste flows** using WaCT and WFD tools to adapt and improve interventions is simple, quick, and is not resource intensive. Ideally, assessments should be conducted seasonally to assess waste fluctuations, and every five years. The tools’ ability to quantify waste flows and community participation ensured tailored interventions.

 Risks & Opportunities

- **Waste baselining becomes a priority for local and national governments:** Governments establish accurate baseline data on plastic waste generation and management to guide interventions and measure progress.
- **Strong enforcement** of separation policies and enforcement mechanisms are still required, supported by KAP survey findings on community willingness for successful implementation.

observing waste collection in CDO



© AMH Philippines, Inc.

Case Study 4.4



Indonesia: Bogor, Depok, Jakarta

WWF Involvement: January 2023 to December 2025

Focus Area: Enabling Framework

PSC Approach: Monitoring and Assessment

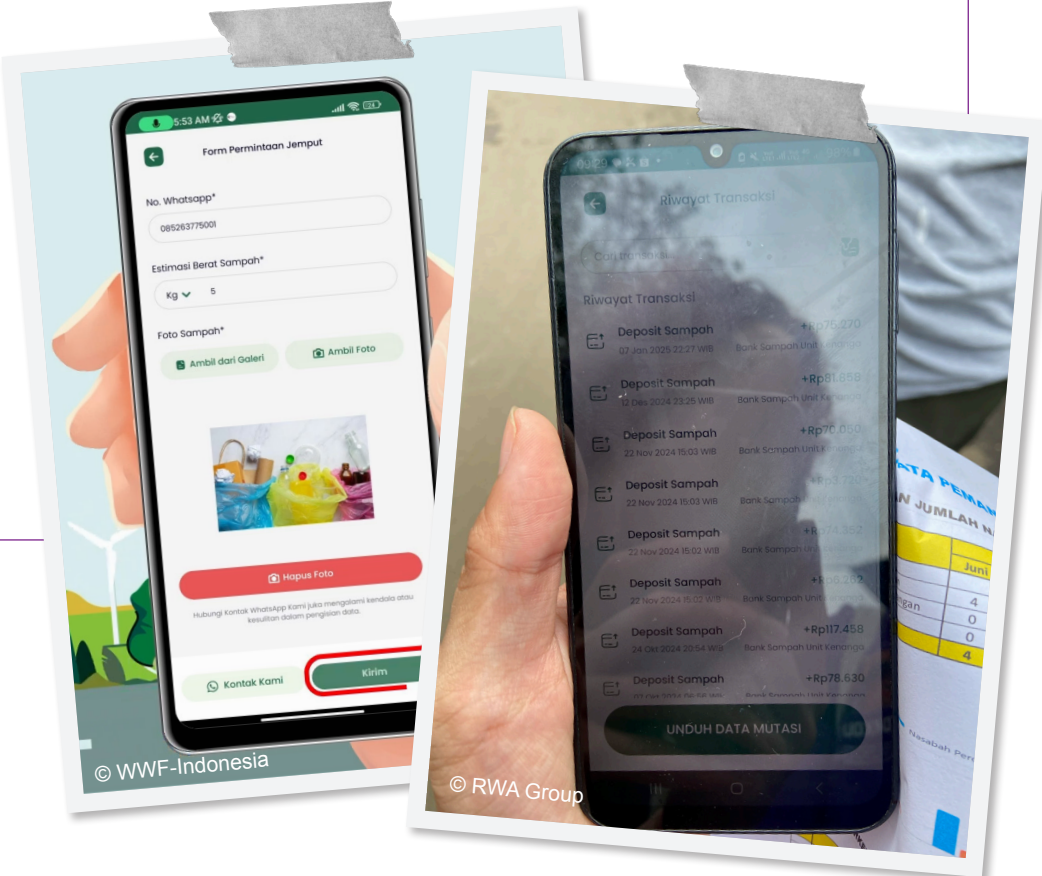
Systemic Intervention:
Systems and Infrastructure

Key Lessons Learned



- **Offline functionality enables continuity in areas with unreliable connectivity:** Offline data entry has allowed transactions to be recorded in areas with limited or unreliable internet access, proving essential for maintaining uninterrupted operations.
- **Ongoing training and community engagement improve user adoption:** Consistent training sessions and regular socialisation events have helped users transition more smoothly to the digital system, reflected in the steady growth of registered users.
- **Technical support and user familiarity are critical when shifting to digital systems:** Transitioning from manual to digital operations benefits from continuous technical support and user training, particularly when partners and customers are less familiar with digital tools.

- **Monitoring and data validation strengthen system performance and trust:** Regular monitoring helps refine the app and drive user engagement, while data validation ensures that uploaded information remains accurate and reflects real conditions on the ground.



Background

[Aplikasi Data Sampah Indonesia](#) (AKSI) is an Indonesian Waste Data Application, available on [Apple Store](#) and [Google Play](#), developed to help waste banks move away from manual record-keeping to a digital system. The objective is to create a more effective, efficient, and transparent waste collection and monitoring system at the community-level, with implementation starting with pilot projects across three cities (Bogor, Depok, Jakarta).

Subsequently, the app will be handed over to the local government for monitoring and evaluation purposes in the next phase of development.

Objectives

- Digitise manual waste data recording processes used by waste banks and their customers (households and non-

- households).
- Provide real-time monitoring and reporting of waste collection and compositions.
- Enhance government monitoring capabilities to support national waste policies.

Key Successes

- **Waste banks can digitally record** the waste collected from their customers (mixed waste, non-organic, and organic waste), track monetary balances and transactions, and provide real-time data to customers on their waste contributions. Key features include waste collection tracking and pickup request functionality. This helps to increase transparency and customer engagement.
- The app was launched in August 2023 and by December 2024, **AKSI had 875 verified individual users** (waste bank customers) and 98 partner users (waste banks and organisations). Users are registered throughout Indonesia.
- **Waste Collection Impact:** The AKSI app facilitated the collection of substantial waste volumes, recording 327 tonnes of plastic waste, 800 tonnes of organic waste, and 41 tonnes of mixed waste from its launch to December 2024.
- **Community engagement:** More than 25 socialisation and training sessions were held, targeting users from various waste banks, including 82 participants in the Bank Sampah Gunung Emas capacity-building workshop. A supplementary [training video](#) was also developed for partners.
- **Offline data entry increases accessibility:** The ability to record transactions offline ensures that waste banks can continue using the system even in areas with poor internet connectivity. This feature has been particularly beneficial for waste banks in remote areas, ensuring uninterrupted operations.

Key Challenges

- The AKSI app currently **does not categorise non-organic waste by specific plastic types**, which affects the level of detail available in the data collected.
- **Change management considerations remain important:** For some users familiar with manual systems, the transition to digital tools has required adjustment. This has been particularly relevant for user groups with lower levels of digital literacy.
- **System optimisation is ongoing:** Users have observed occasional technical issues, such as incorrect waste data displays and transaction inconsistencies. These are being addressed in coordination with the app developers as part of continuous system refinement.
- **E-Pay integration is still in development:** Online financial transaction capabilities are progressing, though subject to regulatory and procedural processes. Once completed, this integration is expected to enhance user convenience. In the interim, transactions continue to be conducted in person.
- **Maintaining data accuracy and verification is an area of continued focus:** Efforts are ongoing to encourage verified users to consistently enter accurate data, as validation and monitoring systems continue to be strengthened.

Resources

Support: WWF partnered with local governments (Bogor, Depok, Jakarta), while covering the costs of app development, socialisation, and partner engagement.

Training and socialisation: Regular training sessions were held by WWF, which boosted some user confidence and engagement, with waste banks reporting improved data accuracy over time.

Enabling Factors

- **Uptake of a digital app** for data logging and monitoring is helpful due to its modular structure and alignment with waste management initiatives.
- **Training and socialisation efforts:** Training sessions and digital materials (online video tutorials) helped build user confidence.

Risks & Opportunities

- **Varying levels of stakeholder familiarity with the app may affect uptake:** Tailored technical support and regular monitoring can help facilitate smoother adoption and ease the transition where additional assistance is needed.
- **Ongoing technical issues within the system may affect user confidence:** Continued improvements and timely updates based on user feedback remain essential to ensuring a reliable and user-friendly experience.
- **Aligning the app with government data systems and regulatory frameworks can present coordination needs:** Early engagement and collaboration with relevant authorities can help ensure compatibility and support smooth integration with official data requirements.
- **Integrating an online payment system may enhance transaction processes and support operational efficiency:** Financial integration has the potential to streamline payments and strengthen the overall functionality of the system.



Replication & Scaling

★ Replication and Scaling

While ‘replication’ and ‘scaling’ are often used together, they are distinct concepts. Replication refers to the transfer of a tested concept to a new location, aiming to repeat success in a new setting. In contrast, scaling means expanding a tested concept to serve more people, strengthen institutions, or other similar targets.

Both replication and scaling are critical to achieving the systemic change needed to meaningfully reduce plastic leakage into nature. While many examples highlighted in this report have piloted promising initiatives — from reuse models to Material Recovery Facilities (MRFs) — it is only by replicating successful models across new locations and

scaling up solutions to broader systems (including policies, markets, and institutions) that widespread impact can be achieved.

Scaling circular economy approaches or ISWM (Integrated Solid Waste Management) is challenging but achievable. Contextual differences such as political commitment, institutional capacity, funding, infrastructure, and social norms mean that exact replication is rarely possible. For instance, implementing a refill station model in an island setting such as Bali, Indonesia, presents different challenges compared to introducing the same concept in a dense urban environment like Jakarta. Adaptation to local context

is critical, and success depends on having the right enabling conditions, including establishing policy and regulations, stakeholder readiness, market access, financing, and institutional capacity.

Efforts should prioritise systemic change by focusing equally on upstream measures (reduce and reuse) and downstream improvements (collection, separation, recovery and recycling). Interventions should aim to reduce plastic generation at the source through context-specific solutions such as bans and phase-outs, reusable packaging systems, refill models, and product redesigns, addressing not just waste management but the root causes of plastic leakage.

Drawing from the PSC case studies and lessons, some of the key factors for successful replication and scaling include:



Political **buy-in** and shared ownership



Existing **policies** or regulations;



Pathway to unlocking **finance** or securing financial sustainability;



Commitment of the **local** community/ organisations/stakeholders;



Training and advocacy for stakeholders' readiness and involvement for capacity building and knowledge transfer



Designing **operational** systems and procedures with baselines and **monitoring** for adaptive implementation.

Importantly, projects that generate high costs but deliver limited value and where the cost per tonne of generated and collected waste is disproportionately high relative to the waste volumes handled should be avoided. This is due to the likelihood of them remaining financially unsustainable in the long-term. Additionally, investing in costly equipment that process only a small fraction of a city's plastic waste - such as shredders or extruders - offers limited return and should not be replicated without strong justification. This is particularly important when considering interventions that have only succeeded due to sustained donation funding in isolated locations, as such models are unlikely to be financially replicable or scalable elsewhere.

Design Principles for Replication and Scaling



Replication

While replication is often context-dependent, where the conditions align, this can be done through having a standardised approach with a guidance or process manual for different sites to replicate.

Contextual considerations may include: geography (urban, rural, density, landscapes, etc.), waste flow baselines, culture, socio-economics, financial viability, and political interest.

Once a proven methodology is established along with the required contextual elements, this approach can be documented and shared with relevant national actors to test replication based on these factors in more pilot sites. Additional steps to consider to ensure sustainability include:

- **Building institutional capacity:** This can be done through training on governance, technical, and financial management, and contract oversight training.
- **Promoting job security, social inclusion, and fair working conditions:** Are important considerations particularly for informal sector workers.
- **Encouraging ongoing knowledge exchange and peer learning:** Maintaining a process to allow practices to evolve and improve - such as between cities or countries at a regional level to further support the replication of approaches.



Scaling (Nationally)

A core pathway to scaling impact is by influencing national-level policy. City-level interventions should serve as models for systems change, demonstrating approaches that can be adapted, and supported at higher levels of governance (Tandemic, 2024). Local actions should always be designed with scalability in mind, considering how successful interventions can inform national or even global efforts. Considerations should include:

- **Designing scalable models:** Interventions should aim to demonstrate practical, effective approaches to plastic waste reduction or management. These models should be embedded into routine municipal operations, local policies, or business practices to ensure long-term integration and replicability.
- **Engaging national actors early:** Scaling requires alignment with national priorities and systems. Relevant national agencies, policymakers, and influencers should be engaged from the start to ensure coherence with existing frameworks and to secure support, financing, and ownership. Embedding interventions into local regulations, service contracts, and national programs helps institutionalize change.
- **Creating feedback loops across governance levels:** Mechanisms should be in place to capture and communicate learnings from local implementation to national stakeholders. This includes collecting credible evidence, highlighting success stories, monitoring systems, and maintaining continuous dialogue to shape policy and respond to emerging challenges.
- **Strengthening alignment with broader policy ecosystems:** Sharing lessons and aligning with regional and international frameworks can further amplify impact. Regional and global frameworks — such as national plastic action plans, extended producer responsibility (EPR) systems, regional plans such as the ASEAN Regional Action Plan for Combating Marine Debris, or global efforts like the Global Plastic Pollution Treaty negotiations — can amplify local impact. Contributing to these broader dialogues supports visibility, resource mobilization, and policy uptake at scale, helping to position city-level work as part of a wider movement for systemic change.

Table 6. Sample Initiatives for Replication and Scaling by PSC Systemic Intervention and Approach Areas

Systemic Intervention (PSC TOC)	PSC Approach	Example Initiatives	Example Case Studies	Enablers
Strategy Development	Local policy and regulation	City Action Plan Development & Implementation (with monitoring) <i>See the City Action Plan template within the PSC Plastic Smart Guide for Cities as an example</i>	4.1	• Strong multi-stakeholder consultation, buy-in, and inter-agency coordination with inclusion of communities and the informal waste sector at the design and implementation stages. • Technical assistance for policy drafting and enforcement with technical options analysis and advocacy for alignment with national or international targets and standards for plastic reduction and waste management. • Political buy-in and institutional/administrative capacity along with financial commitment to ensure sustainability.
Policy Advocacy	Local policy and regulation	Bans and regulations on the most harmful and avoidable plastic products <i>See WWF's Call to Urgently Regulate High-Risk Plastic Products</i>	1.2 1.4 1.6	• International alignment and pressure to formulate policies and regulate high-polluting plastic products at the national, regional, and global levels with strong political buy-in. • A phased approach with strong monitoring and enforcement systems with strict fines and penalties to ensure policy compliance and collaboration between local authorities and businesses/establishments. • Guidance for and availability of affordable, environmentally safe alternatives and/or incentives to facilitate a smooth transition away from high-risk plastic products.
Financing and Funding Mechanisms	Local policy and regulation	Extended Producer Responsibility <i>See more about WWF's approaches to EPR here, including WWF's EPR position paper</i>	1.6 2.4	• Clearly defined legal and institutional regulatory framework to outline expectations of producers at the national level. • Strong monitoring and enforcement mechanisms to support implementation and coordination allowing for the sustainable financing of reduction/reuse and waste collection and recycling systems. • Inclusive design involving local authorities, producers, informal sector, operators and designers.

Table 6. Sample Initiatives for Replication and Scaling by PSC Systemic Intervention and Approach Areas

Systemic Intervention (PSC TOC)	PSC Approach	Example Initiatives	Example Case Studies	Enablers
Knowledge Strengthening	Behavioural Change; Reduction & Reuse; Collection; Recycling	Waste educational programmes integrated into curriculums at schools <i>See the PSC x Schools page for more examples of educational approaches.</i>	1.1 1.2 1.3	• Policy implementation for environmental education and school waste management systems with integration of waste management topics into formal school curricula to ensure long-term impact across local districts and nationally. • Multi-stakeholder collaboration between education, waste management authorities and other stakeholders involved in SWM activities builds lasting partnerships. • Committed governing educational bodies, school leadership and student champions will support encouragement of waste management and reduction efforts over time.
	Reduction; Reuse and Refill; Behavioural Change	Reuse and Refill Models <i>See WWF's Position Paper on The Role of Reuse in a Circular Economy for Plastics and the Reuse Portal for more examples.</i>	1.6	• Incentives for eco-design and reuse innovation with technical support to encourage businesses and users to drive uptake and maintenance for sustainability. • Provision of guidance for standards and certification schemes for reusable products at national level in line with international guidelines to support consumer trust and buy-in. • Regular awareness raising and behavioural change campaigns to enhance and sustain usage locally and nationally. • EPR as a financing mechanism for start-up costs and maintenance.
	Monitoring and Assessment	Baseline assessments/ Regular data collection <i>Refer to the baselining section of the PSC Plastic Smart Guide for Cities and the Benchmark of Plastic Hotspotting Methodologies (GIZ, 2025) for more examples.</i>	4.3	• Local regulations and resources including technical support in place for conducting of quality waste flow baselines, monitoring, and data analysis for evidence-based decision making and adaptive management at both local and national levels. • Multi-stakeholder collaboration through partnerships with local authorities, operators, civil society and communities for ownership and buy-in of data needs. • Data transparency with publically accessible data sharing reduces duplication of efforts and costs.

Table 6. Sample Initiatives for Replication and Scaling by PSC Systemic Intervention and Approach Areas

Systemic Intervention (PSC TOC)	PSC Approach	Example Initiatives	Example Case Studies	Enablers
Systems and Infrastructure	Collection / Recycling / Community-based waste management	Waste Banks	2.5 2.6 2.7 2.8 3.3 4.4	• Availability of a stable market for recovered materials supports sustainability. • Community buy-in particularly from respected leaders supports wider participation. • Support by and integration of informal waste workers enhances the sustainability of operations along with a just transition. • Local government or CSO support for integration into local and national waste management systems along with initial seed funding at start-up and technical support will allow for operational sustainability.
			2.2 4.1	• Strong municipal commitment with regulatory frameworks and budget allocation with cost recovery mechanisms to support ongoing implementation for all, including hard to reach areas, to gain access to basic waste management services. • Strong multi-stakeholder collaboration through partnerships between government, private sector, informal waste systems, and community-based organisations. • Clear improvement in service may encourage residents' willingness to pay. Sharing of positive experiences may encourage local or national replication and scaling.



© Julian Hahne / WWF-Indonesia

Table 6. Sample Initiatives for Replication and Scaling by PSC Systemic Intervention and Approach Areas

Systemic Intervention (PSC TOC)	PSC Approach	Example Initiatives	Example Case Studies	Enablers
Systems and Infrastructure	Separation	Waste Separation at Source <i>See the Participatory Action-Oriented Training (PAOT) Method (WWF-Viet Nam 2024) and the Behavioural Change Toolbox Methodology for Combatting Marine Debris in ASEAN (GIZ 2025) for behavioural change examples</i>	1.1 1.3 1.5 2.1 2.3 4.1 4.2	• Strong municipal support with contract enforcement for the collection operator with clear key performance indicators. • Market assessment conducted to ensure that a diverse range of offtakers for recovered materials are available. • Availability of sustainable collection and recovery equipment and infrastructure. • Awareness campaigns to enhance public willingness, social acceptance and punitive measures. • Incentives, with careful consideration of where in the service/value chains these should be as well as the sustainability of such provisions.
	Recycling	Material recovery facilities	2.8 3.1 3.3 3.4	• Availability of land and infrastructure. • Reliable and consistent waste streams. • Financial and technical support for operational sustainability. • Quality design of MRF and operational logistics, considering current and projected waste volumes, separation processes, and leakage performance standards with documentation of its replicability.
	Collection; Recycling; Monitoring and Assessment	Aggregator app and operations linking consumers or smaller aggregators with offtakers	2.3 3.2 4.4	• Availability of mobile and internet infrastructure or offline solutions where possible to allow for increased accessibility locally or nationally. • Clear incentives including simple, easy-to-use systems encouraging users to participate. • Strong partnerships with waste collectors, traders, recyclers, and buyers allowing for smooth operations.

Table 6. Sample Initiatives for Replication and Scaling by PSC Systemic Intervention and Approach Areas



Investing in a Circular Economy



Investing in a Circular Economy

Investing in circular waste models and waste and resource management (WaRM) needs time and patience. The sector is made up of a series of inter-linked services and facilities, and involves a multitude of stakeholders. Interventions need to be designed based on a good understanding of the existing baseline situation and of the stakeholder landscape. When designing and implementing interventions in upstream reduction efforts or WaRM, what may seem on the surface to be a straight-forward matter of introducing bans or phase-outs, affordable alternative materials, collection systems, or waste recovery and disposal systems, soon reveals itself to equally become an area of governance reform, political, social and economic change. Systematic design and delivery, coupled with strong and stable local delivery partnerships is key.

WWF has been able to facilitate the greatest impact where interventions have targeted missing links. Across different PSC cities, these have included policy frameworks, detailed action plans for collection services, recovery and recycling facilities and markets, reusable/refillable initiatives, and knowledge strengthening through education and awareness. Each city has its own specific circumstances and needs, and there is no 'one size fits all' system in which to design and deliver support. Prioritising interventions that help to fill gaps, where local governments and communities are ready to partner, but lack sufficient resources or technical support, has proven to be key.

A summary of some of the highlights from the PSC project interventions is provided below, along with where WWF support has been/can be most impactful. Additionally, see [PSC's Framework](#) prioritising systemic approaches.



Reduction

Upstream interventions represent opportunities to reduce consumption, addressing waste before it is generated, while midstream interventions target the use phase of plastics. This space remains a priority for transitioning towards a circular economy:

- **Supporting regulatory actions on bans or restrictions on single-use plastic (SUPs)** and other harmful plastic items to curb waste generation at source.
- **Backing business and policy innovations** that focus on eco-design and/or promote environmentally safe plastic alternatives, supporting the ban or phaseout of SUPs.
- **Funding system-wide reuse/refill pilot models** and supporting the development of guidance, toolkits and logistical frameworks for local models at scale rather than smaller fragmented pilots.
- **Investing in behavioural change programmes and public awareness campaigns** to help consumers reduce plastic consumption or drive uptake of reuse/refill models.
- **Co-developing other scalable reduction and reuse solutions** through engaging and co-investing with private sector partners.



Collection and Separation

Downstream collection is the foundation of any functioning integrated solid waste management (ISWM) system. Experience shows that heavy investments are needed for expanding and improving waste separation at source (WSAS) and collection services. Additionally, significant staff time and effort is needed from technical experts to guide stakeholders through processes of change which are complex and dependent on wider sector reform initiatives. The following areas are key and to be performed in collaboration with local governments:

- **Expanding collection services** to underserved areas, particularly peri-urban, rural, and informal settlements where formal collection is limited or non-existent, while upholding [low leakage performance standards](#).
- **Implementing WSAS (two-stream, wet and dry) collection systems**, to minimise contamination, enabling higher quality materials for recovery and recycling. Supporting the required infrastructure, which is reinforced by public education and household engagement initiatives.
- **Supporting community-based collection** operator models that are cost effective and inclusive, ensuring that the community and informal sector are involved in the design and integrated into operations.
- **Collaborating with businesses to implement take-back schemes** (e.g., packaging or electronics collection points) that complement public systems and increase circularity.



Recovery and Recycling

Also downstream, improving interfaces in the recovery and recycling value chains can be integrated into large-scale ISWM infrastructure projects. Investing in recovery and recycling systems and supporting the ISWM system design and planning are key intervention points, addressing:

- **Strengthening of interfaces within value chains**, ensuring seamless connectivity between the collection and recovery/recycling systems and facilities, and between stakeholders and operators.
- **Financing of equipment and systems** to increase the capture and processing of greater quantities of materials for recovery and recycling. This also relies on partnering with locally based organisations.
- **Building of technical skills and knowledge** and professional capacity of local partners in low leakage recovery and recycling operations standards.
- **Investing in planning and design of major downstream infrastructure** including recovery and recycling facilities such as composting, MRFs, and mechanical biological treatment for management by local authorities.
- **Leveraging the private sector to co-develop and scale up recovery and recycling facilities**, market development, and innovation.



Enabling Framework

Supporting factors to establish a circular economy, including policy, legal - institutional and financial, and monitoring and evaluation, dictate the range of possibilities to tackle plastic pollution. Understanding risks is key to maximising impact. Working in the policy sphere builds relations with national and local authorities, enables engagement with stakeholders, and opens opportunities for change. Creating the right incentives and regulatory conditions enables progress across the entire value chain, as follows:

- **Advocating for policy that aligns with circular economy goals** such as legislation that restricts the production and sale of SUPs or other harmful plastic products, tax breaks or subsidies for businesses adopting circular packaging systems or zero-waste retail models, mandatory recycled content laws, and public procurement policies favouring circular products.
- **Investing in public awareness and education initiatives** in collaboration with governments and civil society organisations (CSOs) to increase public engagement and compliance with established policies.
- **Building institutional capacity** by providing technical assistance and training for national and local authorities to effectively design, implement, and enforce circular economy policies. Strengthening inter-agency coordination mechanisms also ensures policy coherence and operational alignment across sectors.
- **Promoting a just transition** by supporting the integration of informal waste workers into formal waste systems with safeguards, recognition, and access to services. Policies should account for social inclusion and equity in the shift to a circular economy.

- **Supporting the development of national or municipal circular economy strategies or roadmaps**, aligned with broader sustainability goals such as SDGs, Nationally Determined Contributions (NDCs), and biodiversity frameworks, to provide clear direction for long-term systemic change.
- **Stimulating circular innovation and markets** by promoting innovation hubs, incubators, or design labs for reuse and recycling solutions, and by developing viable markets for recycled materials through procurement guarantees, standards, and financial risk-sharing mechanisms.
- **Supporting the development and implementation of extended producer responsibility (EPR) and deposit return systems (DRS)** to stabilise the market and increase industry accountability.
- **Backing tariff reform and cost mechanisms** to improve the financial sustainability of SWM services.
- **Promoting public-private partnerships**, to drive scale, unlocking additional finance, and strengthen the service value chain.
- **Providing funding for baselines** of the environmental performance of a city's municipal solid waste management and follow-ups to inform data-driven decision-making for cities and countries.
- **Investing in improved monitoring and evaluation as well as data recording systems** to track progress against establishing a circular economy and inform decision-making.

PSC has demonstrated that well-designed interventions can be financially affordable, socially inclusive, and environmentally acceptable. It is only through a collaborative and adaptive approach that impact can be maximised, ensuring that waste and resource management systems are both economically viable and environmentally sound for future generations.



References



References

1. AMH Philippines Inc. (2024). *Solid Waste Management Baseline Assessment Final Report Cagayan de Oro City, Misamis Oriental*. Philippines. Quezon City.
2. Dayrit, F. (2019) *Picking Up the Baton: Political Will Key to Zero Waste*. Global Alliance for Incinerator Alternatives. Philippines. Available at: <https://www.no-burn.org/wp-content/uploads/2021/11/San-Fernando.pdf>
3. Environmental Justice Foundation. (2024) *Room for Reduction: Towards Sustainable Production and Consumption of Plastics in Thailand*. Available at: https://ejfoundation.org/resources/downloads/EN_Room-for-Reduction_2024.pdf
4. European Environment Agency. (2024) *Economic instruments and separate collection systems—key strategies to increase recycling*. EEA. Available at: <https://www.eea.europa.eu/publications/economic-instruments-and-separate-collection>
5. Guerrero, L. (2019) *Enabling Sustainable Cities Through Zero Waste: A Guide for Decision- and Policy- Makers*. Global Alliance for Incinerator Alternatives-Asia Pacific Office. Philippines. Available at: <https://www.no-burn.org/wp-content/uploads/ZW-policy-makers-FINAL.pdf>
6. Hong Kong Environment Bureau. (2021) *Waste Blueprint for Hong Kong 2035*. Available at: https://www.eeb.gov.hk/sites/default/files/pdf/waste_blueprint_2035_eng.pdf
7. Katz, D. (2019). *Plastic Bank: Launching Social Plastic® Revolution*. Available at: <https://www.institut.veolia.org/sites/g/files/dvc2551/files/document/2019/03/96%20Plastic%20Bank%20launching%20Social%20Plastic%20revolution,%20David%20Katz.pdf>
8. Nofita et al. (2024). Inspiring Stories of Community-Based Waste Management: Sharing Experiences Across Indonesia via Participatory Action Research. Plastic smart cities Indonesia. Available at: <https://plasticsmartcities.org/inspiring-stories-of-community-based-waste-management-sharing-experiences-across-indonesia-via-participatory-action-research/>
9. OECD (2021). *Modulated fees for Extended Producer Responsibility schemes (EPR)*. OECD Publishing. Available at: https://www.oecd.org/en/publications/modulated-fees-for-extended-producer-responsibility-schemes-epr_2a42f54b-en.html
10. Pfaff-Simoneit, W. (2023). Enhancing Labor-intensive Separate Waste Collection and Utilization in APEC Economies. APEC Ocean and Fisheries Working Group. Singapore. Available at: <https://www.apec.org/publications/2023/01/enhancing-labor-intensive-separate-waste-collection-and-utilization-in-apec-economies>
11. Prevent Waste Alliance (2020). *The Republic of Korea's EPR system for packaging: an Asian role model*. Available at: <https://prevent-waste.net/wp-content/uploads/2023/06/Republic-of-Korea.pdf>
12. PREVENT Waste Alliance. (2022) *EPR Toolbox: Know-how to enable Extended Producer Responsibility for packaging*. German Federal Ministry for Economic Cooperation and Development (BMZ). Available at: https://prevent-waste.net/wp-content/uploads/2023/07/PREVENT-Toolbox-interactivePDF_2022lowres.pdf
13. SD39 Group and PXP Sustainability. (2025). *Study on Best Practices, Gap Analysis, and Policy Recommendations for the Plastic Smart Cities Thailand Project*. WWF.
14. Soós, R., Whiteman, A., Wilson, D.C., Briciu C., Schwehn, E. (2013) *Operator Model. Respecting Diversity. Concepts for Sustainable Waste Management*. Available at: <https://rwm.global/utilities/documents/giz2013-swm-operator-models-sourcebook-en.pdf>
15. Suparmini, Purnawan. (2018) *The Role of Waste Bank Partnership in Efforts to Decrease Waste Volume in Urban: A Case Study at a Waste Bank in Kalibaru, Cilodong, Depok City*. Earth and Environmental Science. Available at: <https://iopscience.iop.org/article/10.1088/1755-1315/126/1/012125/pdf>
16. Tandemic. (2024). *WWF Plastic Smart Cities 2.0 Design Principles Design for scalability*. Plastic Smart Cities.
17. Thanh Hai T., Vu, N. (2019) *European Journal of Engineering Research and Science* 4(9):107-111. Available at: https://www.researchgate.net/publication/358595714_Crisis_of_Plastic_Waste_in_Vietnam_is_Real
18. The Impact Hub. (2021) *Scaling and Replication: A way to grow your impact*. Available at: <https://o4my.org/wp-content/uploads/2021/12/A-way-to-grow-your-impact-MedUP-Toolkit.pdf>
19. UN SG's Advisory Board on Zero Waste. (2024) *Project Zero: Zero Waste Schools*. Women for India Foundation. Available at: https://unhabitat.org/sites/default/files/2024/04/project_zero.pdf

20. UNEP. (2022) *Identifying Plastic Waste Leakage Hotspots and Flows in Southeast Asia*. Kenya. Available at: <https://wedocs.unep.org/handle/20.500.11822/41689>
21. UNEP. (2024) *Global Waste Management Outlook: Beyond an Age of Waste – Turning Rubbish into a Resource*. Nairobi. Available at: <https://www.unep.org/resources/global-waste-management-outlook-2024>
22. UN-Habitat. (2021). *Waste Wise Cities Tool: Step by Step Guide to Assess a City's Municipal Solid Waste Management Performance through SDG indicator 11.6.1 Monitoring*. Available at: <https://unhabitat.org/sites/default/files/2021/02/Waste%20wise%20cities%20tool%20-%20EN%203.pdf>
23. Whiteman, A., Webster, M., Wilson, D.C. (2021) *The nine development bands: a conceptual framework and global theory of waste and development*. Available at: <https://journals.sagepub.com/doi/full/10.1177/0734242X211035926>
24. World Bank. (2018) *Municipal Solid Waste Management: A Roadmap for Reform for Policy Makers*. Washington. Available at: https://openknowledge.worldbank.org/server/api/core/bitstreams/b82c9536-3c48-52c5-9190-5bc64cbb7c06/content?utm_source=chatgpt.com
25. World Bank, 2018. *What a Waste 2.0: A global snapshot of solid waste management to 2050*. Washington, DC: World Bank. <https://documents1.worldbank.org/curated/en/697271544470229584/pdf/132827-PUB-9781464813290.pdf>
26. World Bank. (2021) *Bridging the Gap in Solid Waste Management Governance Requirements for Results*. World Bank, Washington. Available at: <https://documents1.worldbank.org/curated/en/459431622213523067/pdf/Bridging-the-Gap-in-Solid-Waste-Management-Governance-Requirements-for-Results.pdf>
27. World Bank. (2022) *Vietnam: Plastic Pollution Diagnostics*. Available at: <https://documents1.worldbank.org/curated/en/099731406282241639/pdf/P1673070d02f2c0be080740356b6b0e3deb.pdf>
28. World Wide Fund for Nature. (2024a). *AKSI Activity Report*. Indonesia. Jakarta.
29. World Wide Fund for Nature. (2024b). *Cu Lao Cham's Material Recovery Facility – Impact Evaluation*. Hoi An, Viet Nam.
30. Worldwide Fund for Nature. (2024c). *Optimizing Impact Portfolio Management 2023-2025: Project Sustainability and Positioning Strategy*. Plastic Smart Cities. Indonesia.
31. Worldwide Fund for Nature. (2024d). *Optimizing Impact Portfolio Management 2023-2025: Project Sustainability and Positioning Strategy for Thai Ocean Plastic Recycling*. Plastic Smart Cities. Thailand.
32. Worldwide Fund for Nature. (2024e) *The Plastic Reduction Journey of Hue City*. Hue University. Viet Nam. Available at: <https://plasticsmartcities.org/wp-content/uploads/2024/11/The-Plastic-Reduction-Journey-of-Hue-City.pdf>
33. WWF KII 01. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
34. WWF KII 02. (2024). Key Informant Interview with WWF Staff, Viet Nam. Conducted November 2024.
35. WWF KII 03. (2024). Key Informant Interview with WWF Staff, Thailand. Conducted December 2024.
36. WWF KII 04. (2024). Key Informant Interview with WWF Staff, Thailand. Conducted December 2024.
37. WWF KII 05. (2024). Key Informant Interview with WWF Staff, Viet Nam. Conducted December 2024.
38. WWF KII 06. (2024). Key Informant Interview with WWF Staff, Philippines. Conducted December 2024.
39. WWF KII 07. (2024). Key Informant Interview with WWF Staff Thailand. Conducted December 2024.
40. WWF KII 08. (2024). Key Informant Interview with WWF Partner, Thailand. Conducted December 2024.
41. WWF KII 09. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
42. WWF KII 10. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
43. WWF KII 11. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
44. WWF KII 12. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
45. WWF KII 13. (2024). Key Informant Interview with WWF Staff, Viet Nam. Conducted December 2024.
46. WWF KII 14. (2025). Key Informant Interview with WWF Partner, Indonesia. Conducted January 2025.
47. WWF KII 15. (2025). Key Informant Interview with WWF Staff, Philippines. Conducted January 2025.
48. WWF KII 16. (2024). Key Informant Interview with WWF Partner, Thailand. Conducted December 2024.
49. WWF KII 17. (2025). Key Informant Interview with WWF Staff, Indonesia. Conducted January 2025.

Plastic Smart Cities support urban centres, coastal areas, and tourism hotspots to co-create solutions that prevent plastic from leaking into nature — delivering real change through circular systems and inclusive action.



Working to sustain the natural world for the benefit of people and wildlife.

together possible™

panda.org

© 2025

© 1986 Panda symbol WWF – World Wide Fund for Nature (Formerly World Wildlife Fund)

® “WWF” is a WWF Registered Trademark. WWF, Avenue du Mont-Bland, 1196 Gland, Switzerland. Tel. +41 22 364 9111. Fax. +41 22 364 0332.

For contact details and further information, please visit our international website at www.panda.org

For more information about the Plastic Smart Cities, please visit: plasticsmartcities.org